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TECHNICAL NOTE



Research & Development Division
 Huntsville Research & Engineering Center
 4800 Bradford Drive, Huntsville, AL 35807

Contract	NAS8-34978	Date	11 December 1984	Doc.	LMSC-HREC Th D951714
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Title	BEARING TESTER FIT ANALYSIS
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(NASA-CH-171282) BEARING TESTER FIT ANALYSIS (Lockheed Missiles and Space Co.)
 75 p HC A04/MF A01 CSCL 131 N85-16181
 Unclassified
 G3/37 13716

FOREWORD

This technical note was prepared by personnel at Lockheed's Huntsville Research & Engineering Center under Contract NAS8-34978 for NASA-Marshall Space Flight Center. The NASA Contracting Officers Representative for this contract is Mr. Kenneth E. Riggs, EP23.

DISCUSSION

A NASTRAN model of the Bearing Tester was developed to determine the fit of its components while in use. The model was executed for three loading conditions involving appropriate thermal and pressure loading throughout: rotation (30,000 rpm), rotation with 5000 lb axial shaft loading, and rotation with 2000 lb lateral shaft loading. Selected displacement output data were extracted and processed with design dimensions to provide the information on the following pages.

A 30 deg slice of the Bearing Tester was modeled with solid isoparametric elements (CIHEX). Five more slices were generated to form a 180 deg symmetrical half. Each component was modeled separately for two reasons: (1) in the heat transfer version each component required covering with appropriate heat transfer coefficient elements, and (2) for the displacement

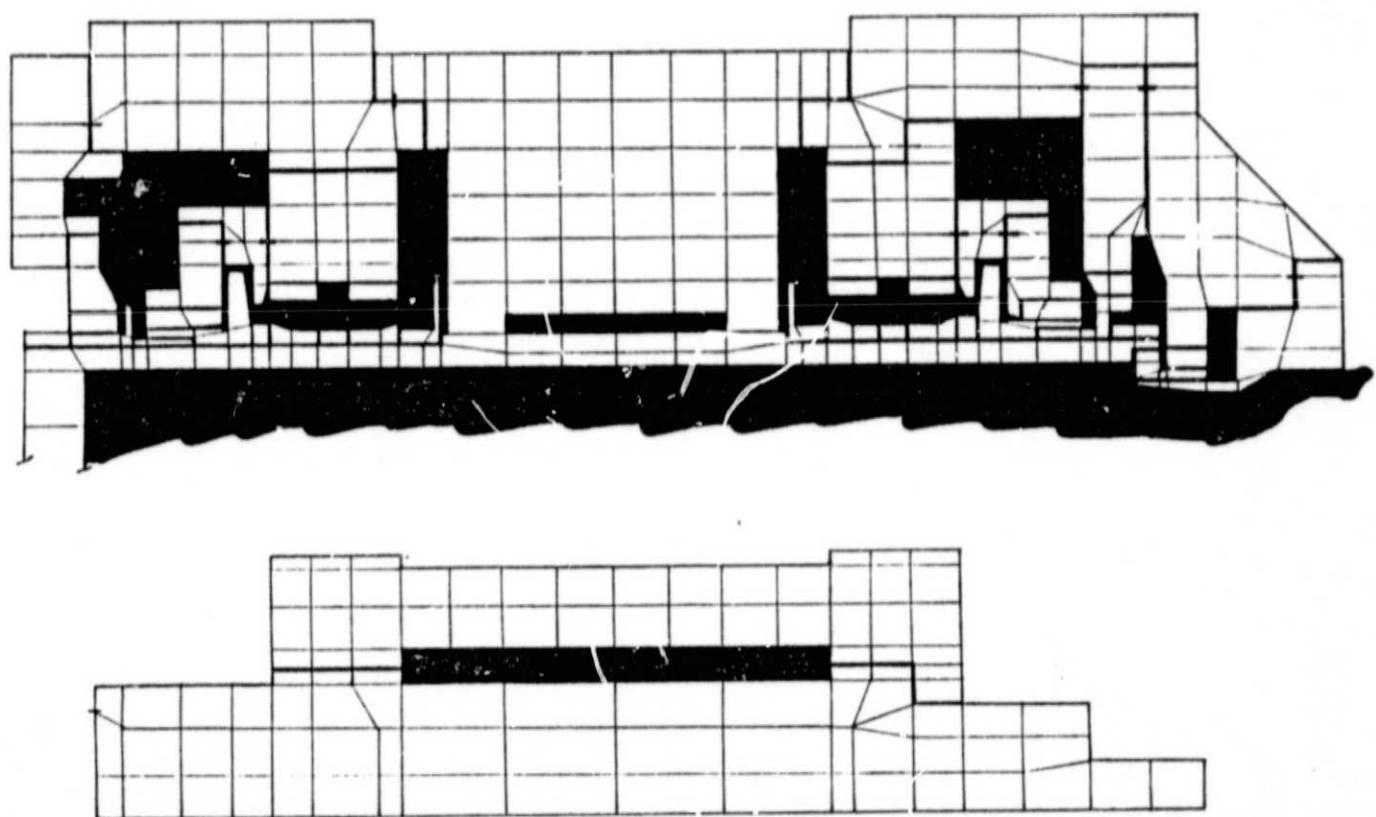


Fig. 1 NASTRAN Bearing Tester Model Typical Element Layout

Table 1 INTERFACE LOCATIONS

A	Housing to Carrier (Left Side)
B	Housing to Carrier (Right Side)
C	Inlet Cap to Bulkhead
D	Housing to Load Cavity Seal Support
E	Kel F Seal to Shaft Extension Plug
F	K Model Nut to Shaft (Right)
G	Kel F Seal to Axial Labyrinth Seal
H	Kel F Seal to Slinger (Right)
I	Housing to Bulkhead
J	Kel F Seal to Slinger (Left)
K	Inconel 718 Seal to Helium Seal (Left)
L	Housing to Bulkhead
M	K Monel Nut to Shaft (Left)
N	Seal Support to Seal Carrier (Right)
O	Seal Support To Seal Carrier (Right)
P	Slinger to Seal Support (Left)
Q	Slinger to Seal Support (Right)
R	Carrier to Outer Race 1
S	Carrier to Outer Race 2
T	Carrier to Outer Race 3
U	Carrier to Outer Race 4
V	Shaft Extension Plug to Inlet Cap
W	Piston to Housing
X	Saddle to Shaft
Y	Housing to Carrier Large Radius

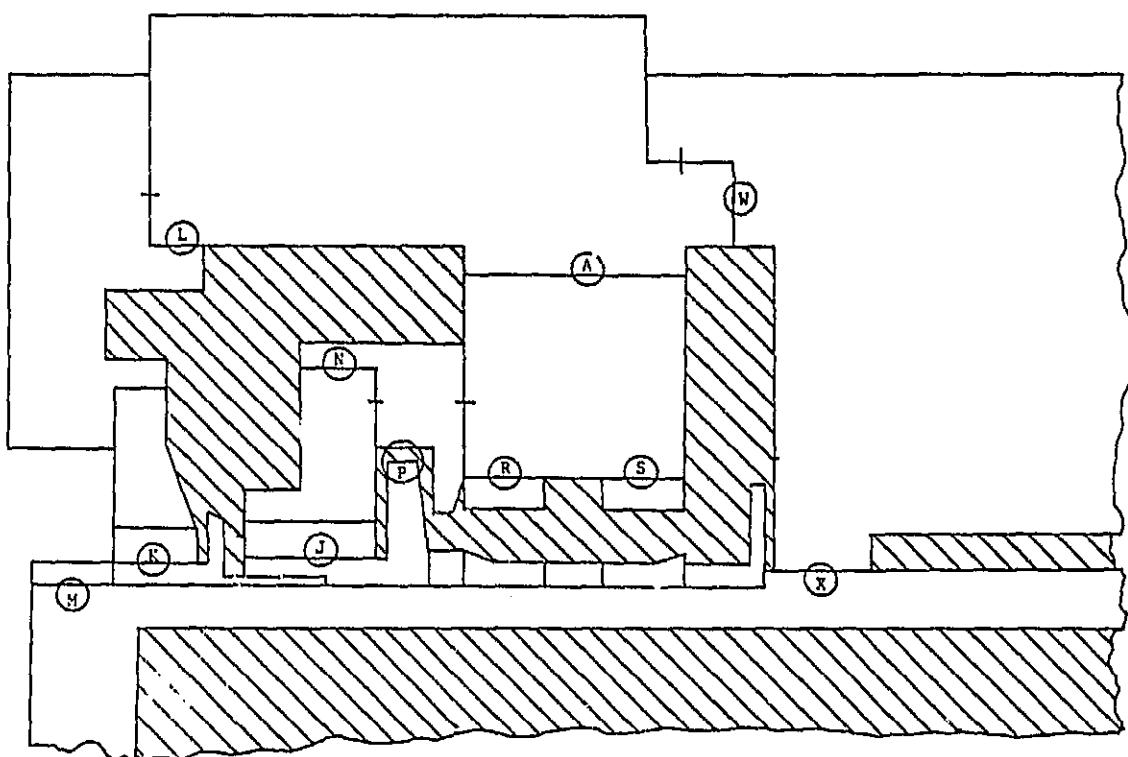


Fig. 2 Bearing Tester Interface Locations (Drive Side)

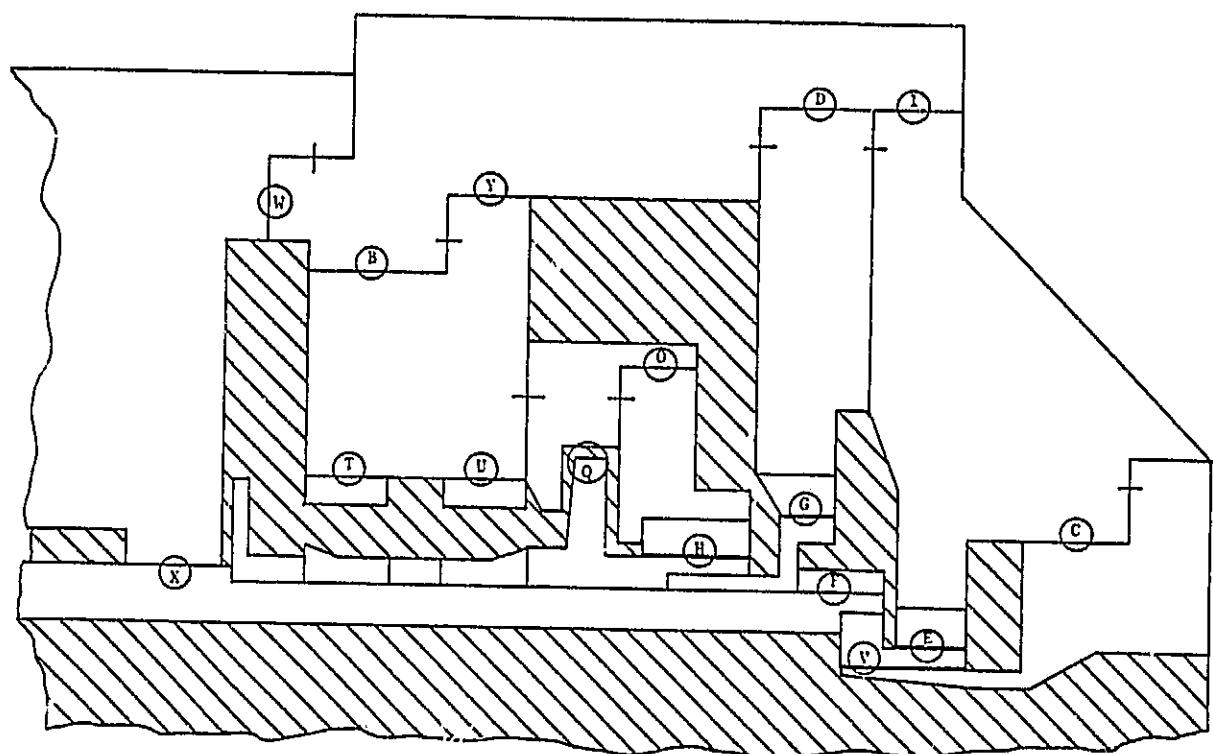


Fig. 3 Bearing Tester Interface Locations (Load Side)

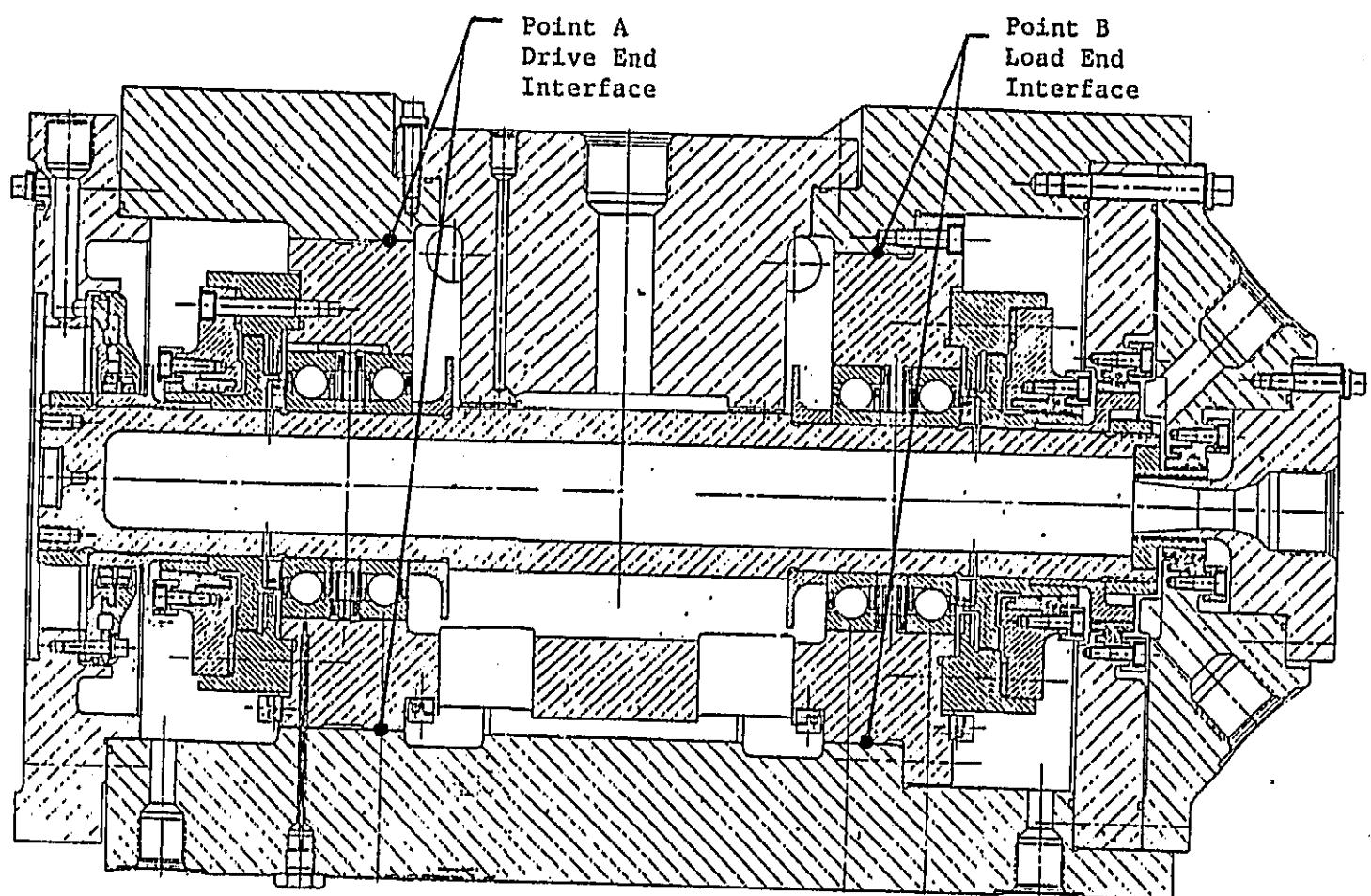


Fig. 4 Housing-to-Bearing Carrier Interface

Table 2 HOUSING (30A85210) TO BEARING CARRIER
DRIVE SIDE, POINT A

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Housing i.d.	7.5020	7.5015
		Bearing Carrier o.d.	7.4995	7.5000
		Fit	(+.0025)	(+.0015)
2	Lube	Housing i.d.	7.5018	7.5011
		Bearing Carrier o.d.	7.4997	7.5004
		Fit	(+.0021)	(+.0007)
3	Rotation	Diametric Change Due to Rotation	-.002690	-.003869
4		Net Fit - Bare: 1 + 3 Lube: 2 + 3	-.00019 (-.00059)	-.002369 (-.003169)
5	Axial	Diametric Change Due to Axial	-.002691	-.003881
6		Net Fit - Bare: 1 + 5 Lube: 2 + 5	-.000191 (-.000591)	-.002381 (-.003181)
7	Lateral	Diametric Change Due Lateral	-.002692	-.003876
8		Net Fit - Bare: 1 + 7 Lube: 2 + 7	-.000192 (-.000592)	-.002376 (-.003176)

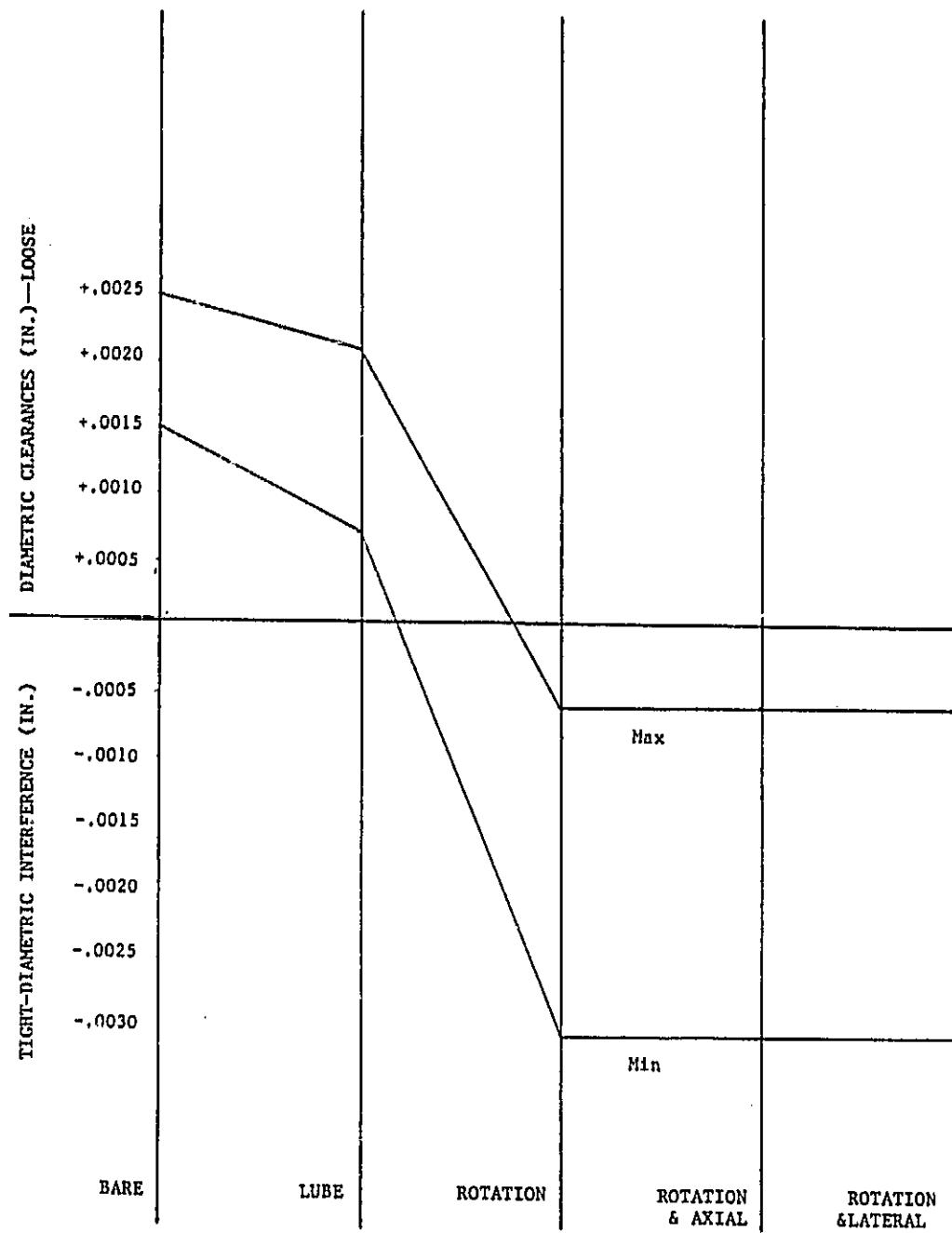


Fig. 5 Interface Fit Summary Plot for Housing-to-Bearing Carrier (Point A)

Table 3 HOUSING (30A85210) TO BEARING CARRIER
DRIVE SIDE, POINT B

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Housing i.d.	7.5020	7.5015
		Bearing Carrier o.d.	7.4995	7.5000
		Fit	<u>+.0025</u>	<u>+.0015</u>
2	Lube	Housing i.d.	7.5018	7.5011
		Bearing Carrier o.d.	7.4997	7.5004
		Fit	(+.0021)	(+.0007)
3	Rotation	Diametric Change Due to Rotation	-.003024	-.003828
		Net Fit - Bare: 1 + 3	-.005524	-.002328
		Lube: 2 + 3	(-.000924)	(-.003128)
5	Axial	Diametric Change Due to Axial	-.003205	-.0039178
		Net Fit - Bare: 1 + 5	-.000705	-.002418
		Lube: 2 + 5	(-.001105)	(-.003218)
7	Lateral	Diametral Change Due to to Lateral	-.002959	-.003716
		Net Fit - Bare: 1 + 7	-.000459	-.002216
		Lube: 2 + 7	(-.000859)	(-.003016)

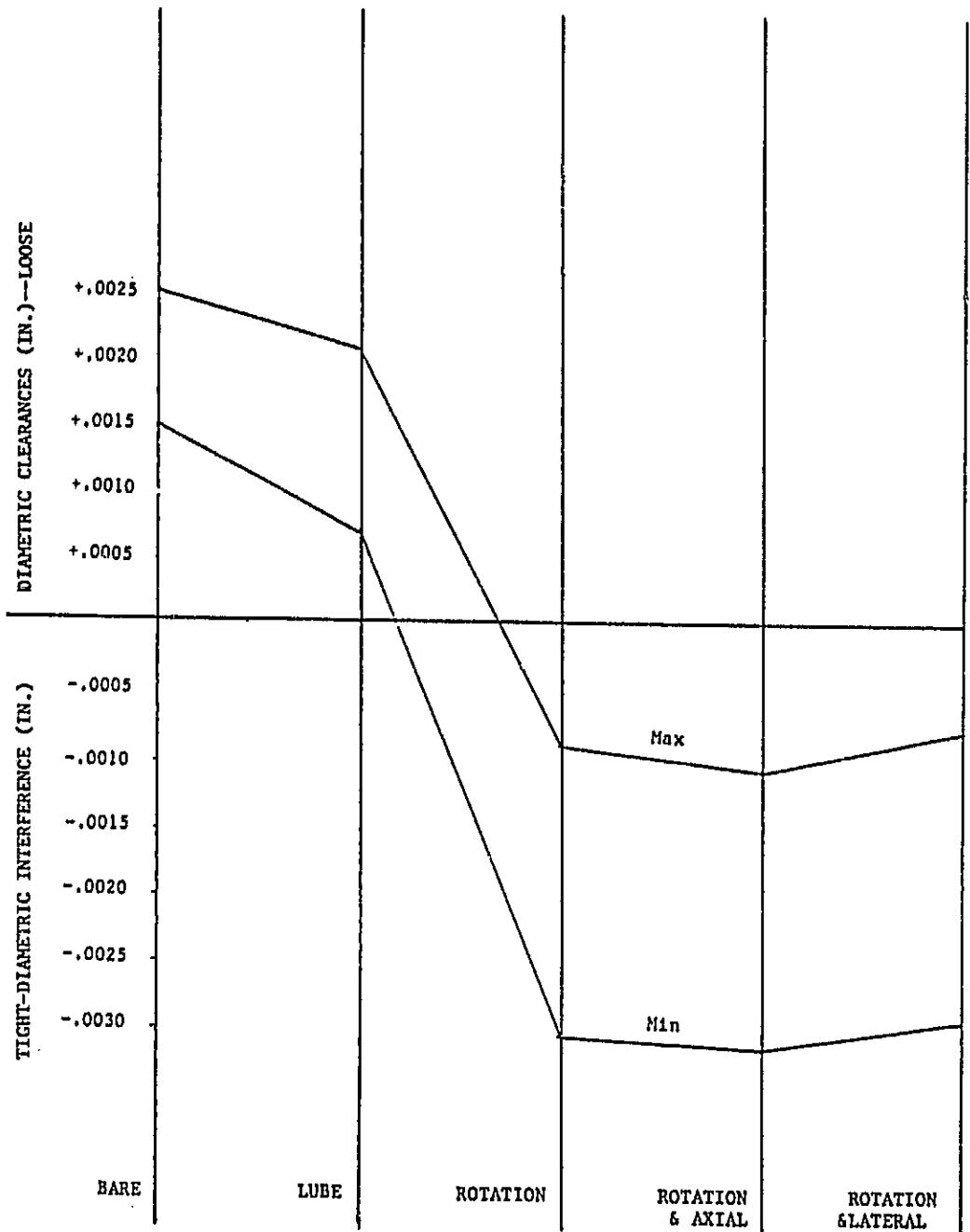


Fig. 6 Interface Fit Summary Plot for Housing-to-Bearing Carrier (Point B)

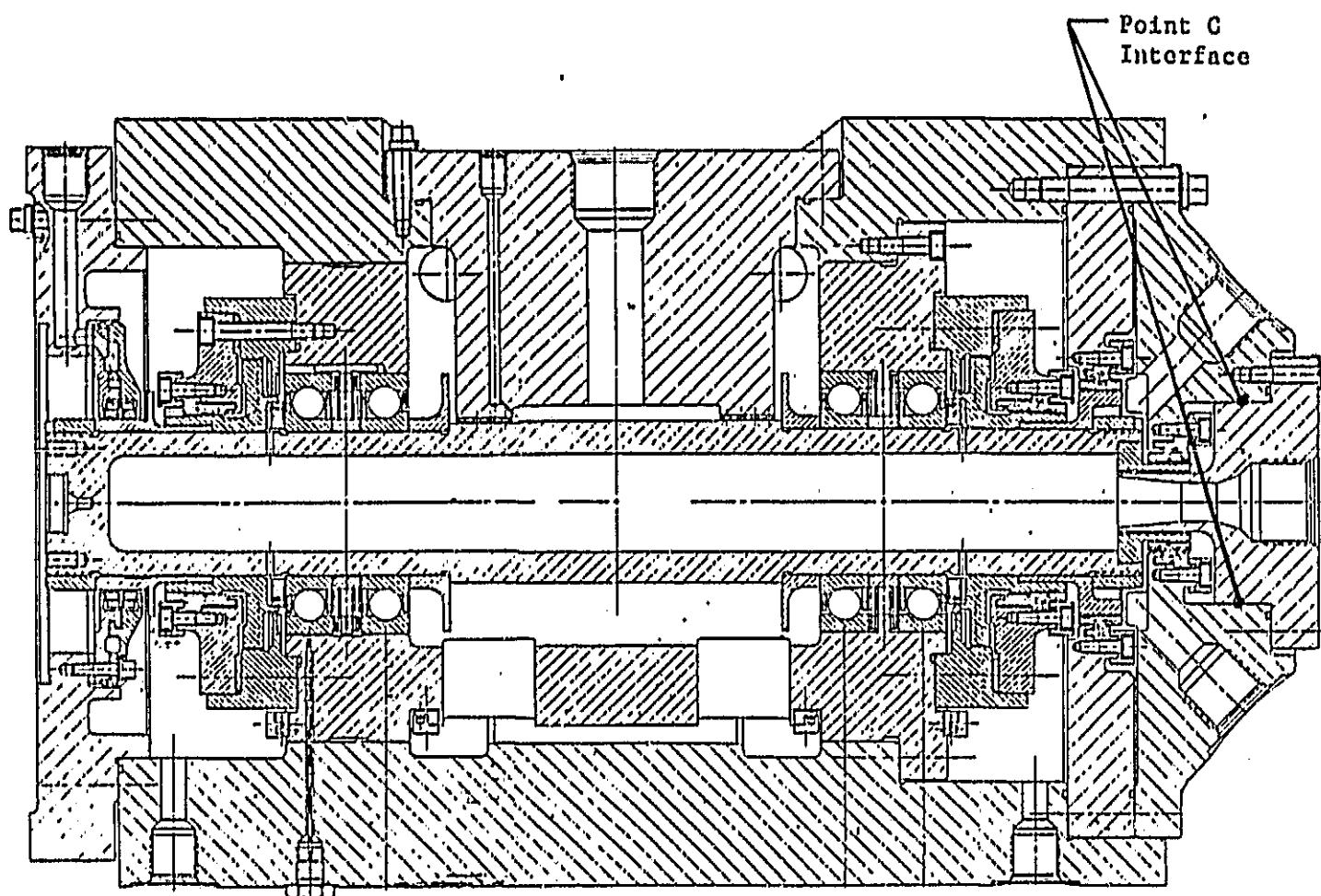


Fig. 7 Bulkhead-to-Inlet Cap Interface

Table 4 BULKHEAD (30A85227) TO INLET CAP (30A85228) POINT C

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Bulkhead i.d.	3.1258	3.1254
		Inlet Cap o.d.	3.1246	3.1250
		Fit	+.0012	-.0004
2	Tube	Bulkhead i.d.	3.1256	3.1250
		Inlet Cap o.d.	3.1248	3.1254
		Fit	+.0008	-.0004
3	Rotation	Diametral Change Due to Rotation	+.0003655	+.0001168
4		Net Fit - Bare: 1 + 3 Lube: 2 + 3	+.001566 (+.0011655)	+.0005168 (-.0002832)
5	Axial	Diametric Change Due to Axial	+.0006428	+.0005889
6		Net Fit - Bare: 1 + 5 Lube: 2 + 5	.001843 (+.001443)	-.0009889 (+.0001889)
7	Lateral	Diametral Change Due to to Lateral	+.0003658	+.0001175
8		Net Fit - Bare: 1 + 7 Lube: 2 + 7	.001566 (+.001166)	+.0005175 (-.0002825)

version each component required independent radial expansion with respect to adjacent components. The components are connected at fastener and bearing locations axially and/or tangentially.

The difference in radial displacements of adjacent cylindrical surfaces were calculated and added to those differences calculated for 180 deg opposite locations to determine the diametric change. The maximum and minimum diametric change for each considered surface was used with the bare and lubricated fits to produce the tables and graphs presented herein.

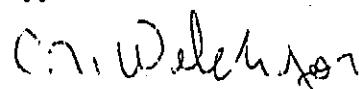
Figure 1 gives the typical element layout and element density for a section of the NASTRAN Bearing Tester model. Table 1 gives the fit location point designations and descriptions for the points of analysis given in Figs. 2 and 3. Figures 4, 7, 9 etc., through Fig. 46 show the fit locations for Tables 2 through 26.

Figures 5, 6, 8, etc., through Fig. 47, present plots of maximum and minimum fits for each fit location.



D. M. Tilley
Dynamics & Loads Group

Approved:



V.L. Wilson, Leader
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C.T. Welch, Manager
Mechanical Systems Section

Attach: (1) Tables 1 through 23
(2) Figures 1 through 41

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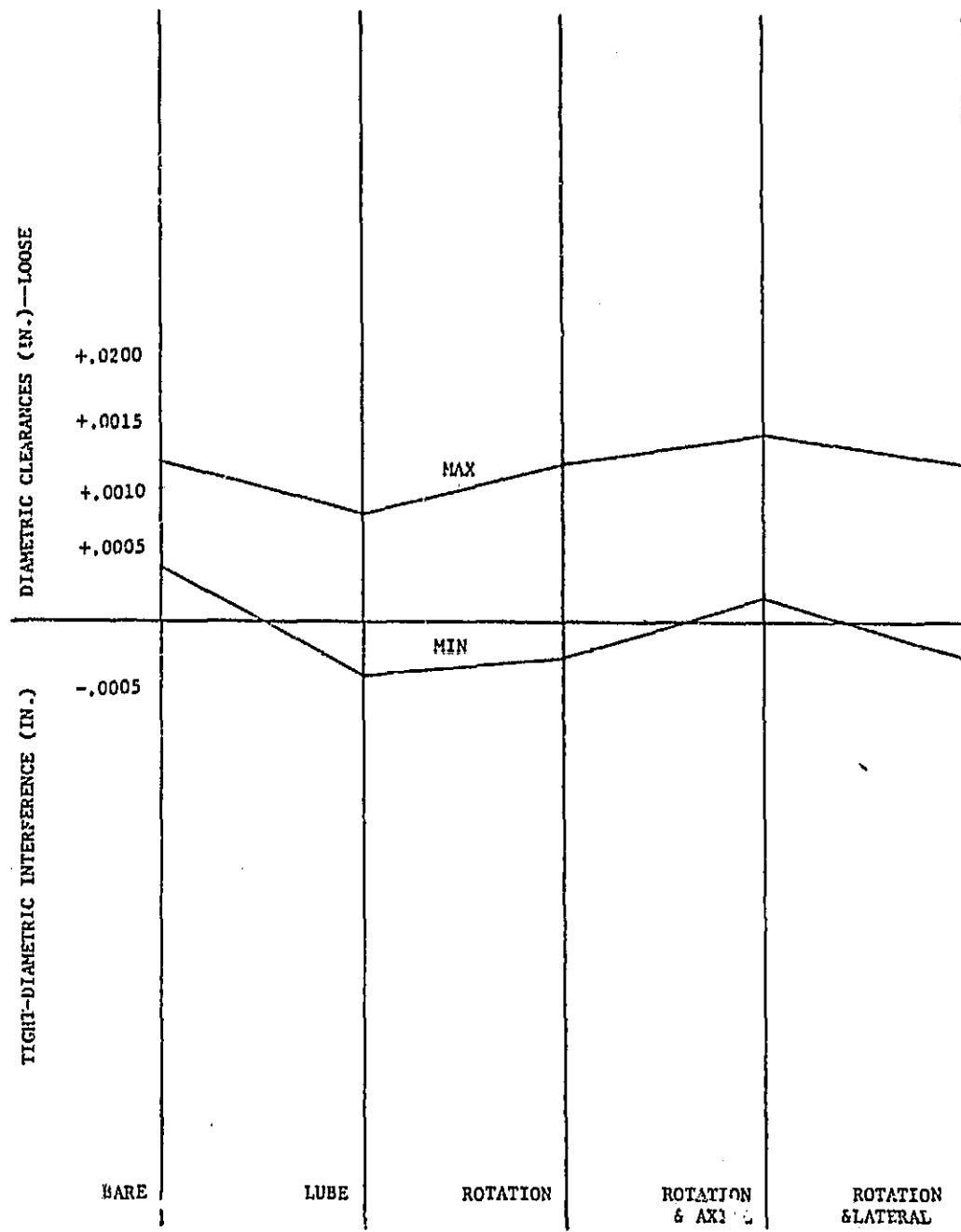


Fig. 8 Interface Fit Summary Plot for Bulkhead to Inlet Cap (Point C)

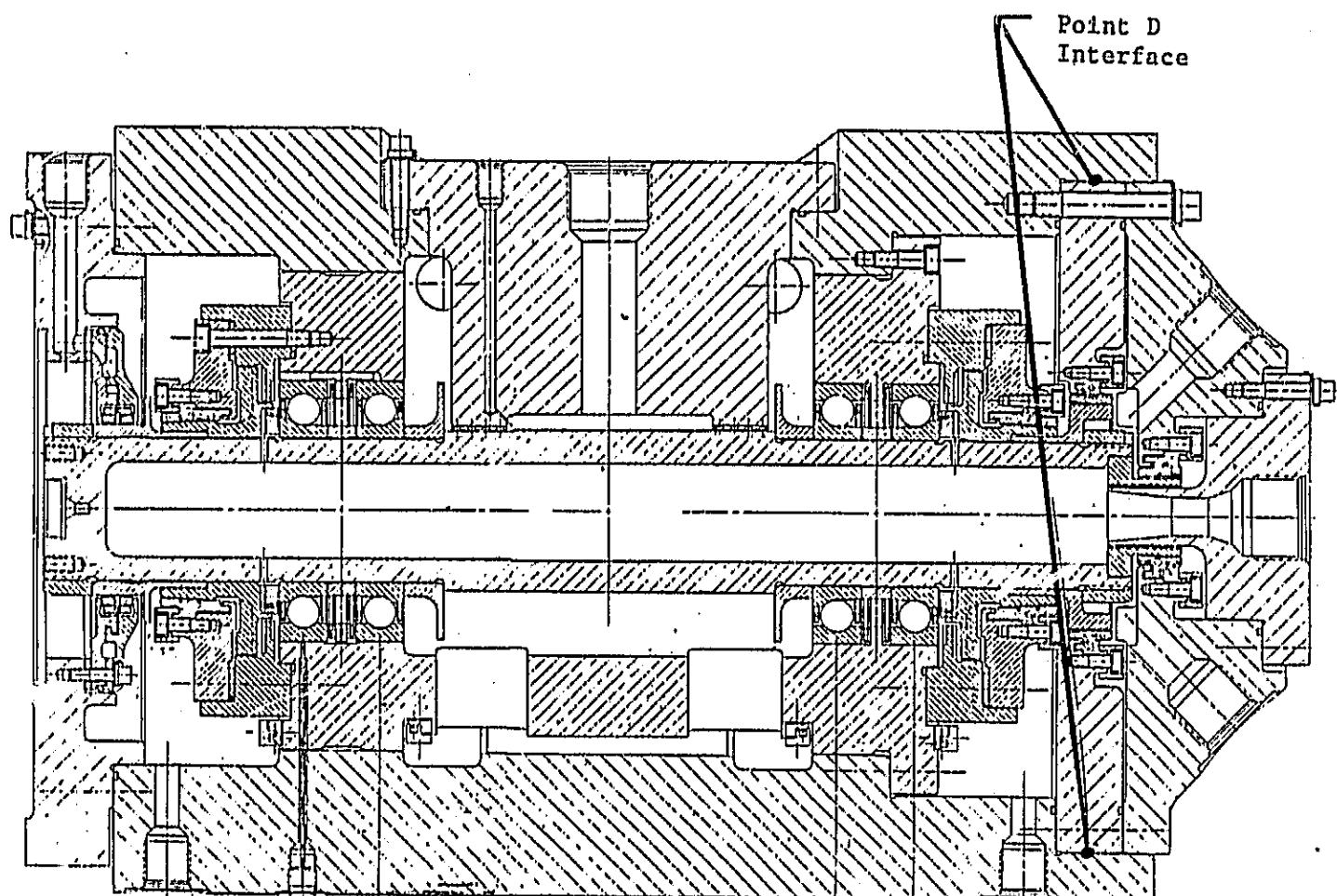


Fig. 9 Housing-to-Load Cavity Seal Support

Table 5 HOUSING (30A85210) TO LOAD CAVITY SEAL SUPPORT (30A85229),
POINT D

SL No.	Load Case	Detail	Diametric Fit		
			Max.	Min.	
1	Bare	Housing i.d.	10.5016	10.5008	
		Seal Support o.d. Fit	10.4992	10.5000	
		Fit	+.0024	+.0008	
2	Lube	Housing i.d.	10.5014	10.5004	
2		Seal Support o.d.	10.4994	10.5004	
		Fit	+.002	+.0000	
3	Rotation	Diametric Change Due to Rotation	+.001959	+.001564	
4		Net Fit - Bare: 1 + 3	+.004359	+.002364	
		Lube: 2 + 3	(+.003959)	(+.001564)	
5	Axial	Diametric Change Due to Axial	+.002051	+.0002844	
6		Net Fit - Bare: 1 + 5	+.004451	+.001084	
		Lube: 2 + 5	(+.004051)	(+.0002844)	
7	Lateral	Diametric Change Due to Lateral	+.001928	+.001565	
8		Net Fit - Bare: 1 + 7	+.004328	+.002365	
		Lube: 2 + 7	(+.003928)	(+.001565)	

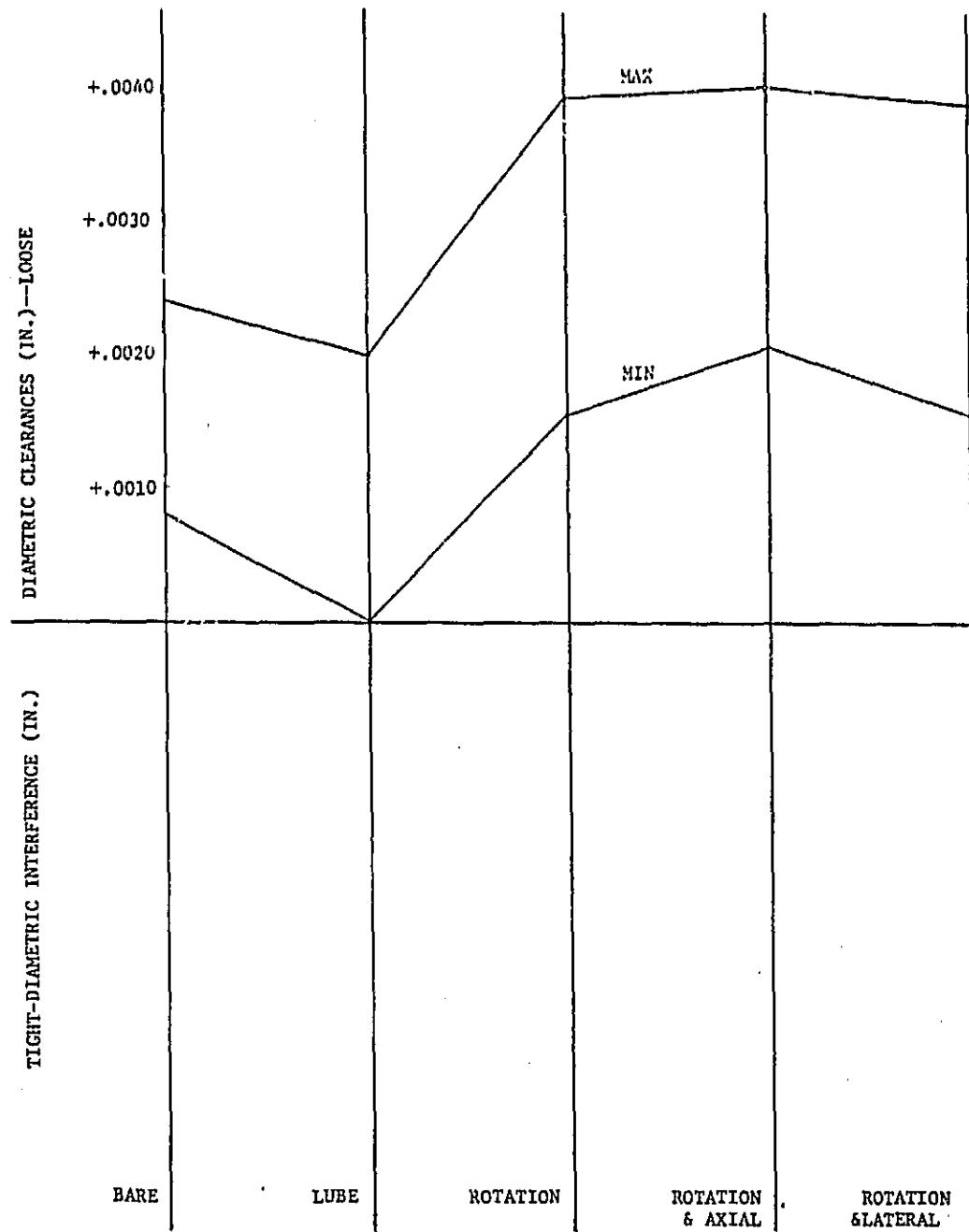


Fig. 10 Interface Fit Summary Plot for Housing-to-Load Cavity Seal Support (Point D)

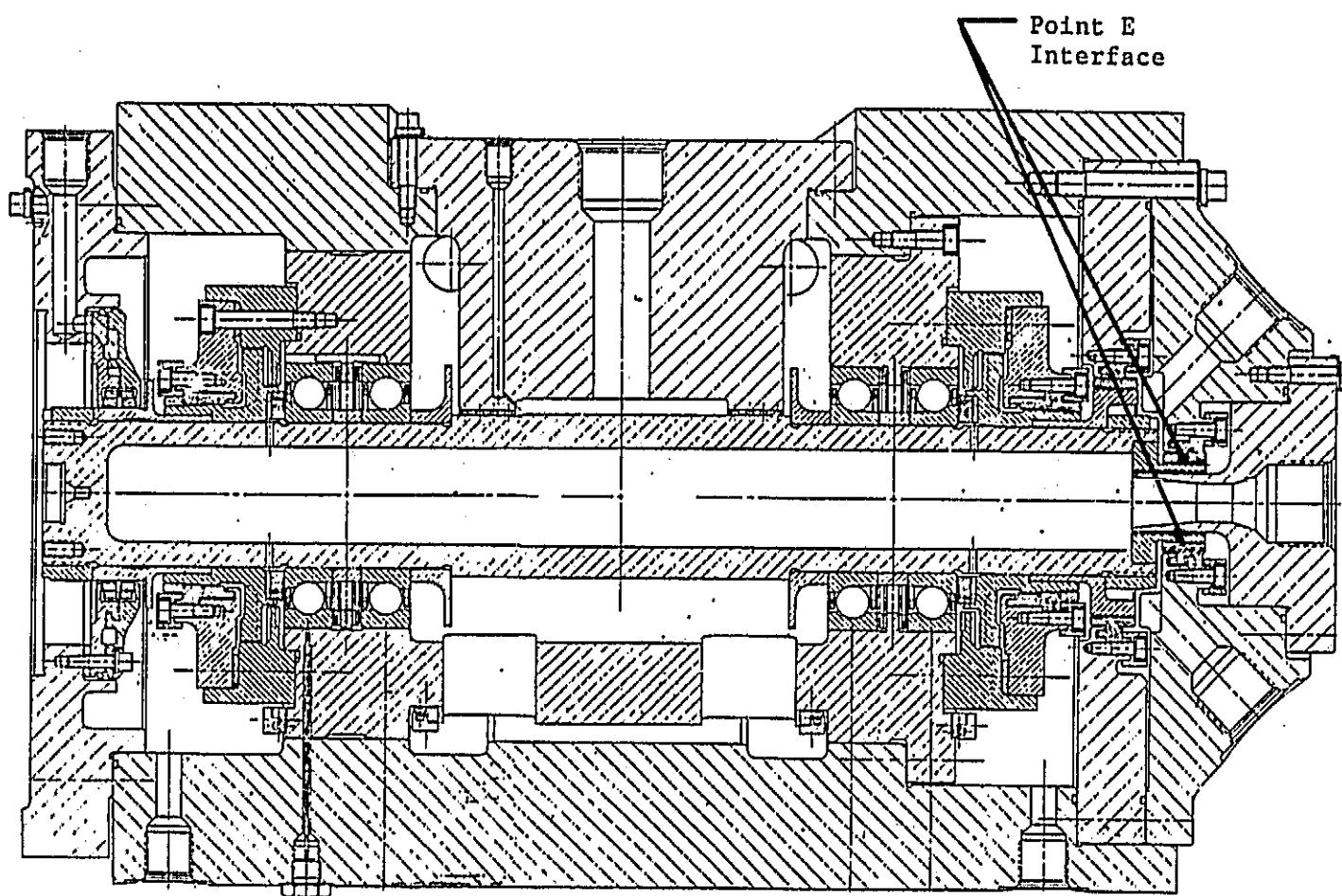


Fig. 11 Kel F Seal-to-Shaft Extension Plug

Table 6 KEL F INLET SEAL (30A85231) TO SHAFT EXTENSION PLUG (30A85212),
POINT E

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
	Bare (Model)	Interface Inlet Seal/Plug	1.240	1.240
1	Rotation	Inlet Seal i.d. Change	-.008048	-.0119566
2		Plug o.d. Change	-.002417	-.002446
3		Net Fit 1 - 2 = 3	-.005631	-.009511
4	Axial	Inlet Seal i.d. Change	-.008069	-.009210
5		Plug o.d. Change	-.002496	-.002418
6		Net Fit 4 - 5 = 6	-.005573	-.006792
7	Lateral	Inlet Seal i.d. Change	-.008047	-.011959
8		Plug o.d. Change	-.002417	-.002446
		Net Fit 7 - 8 = 9	-.005630	-.009513

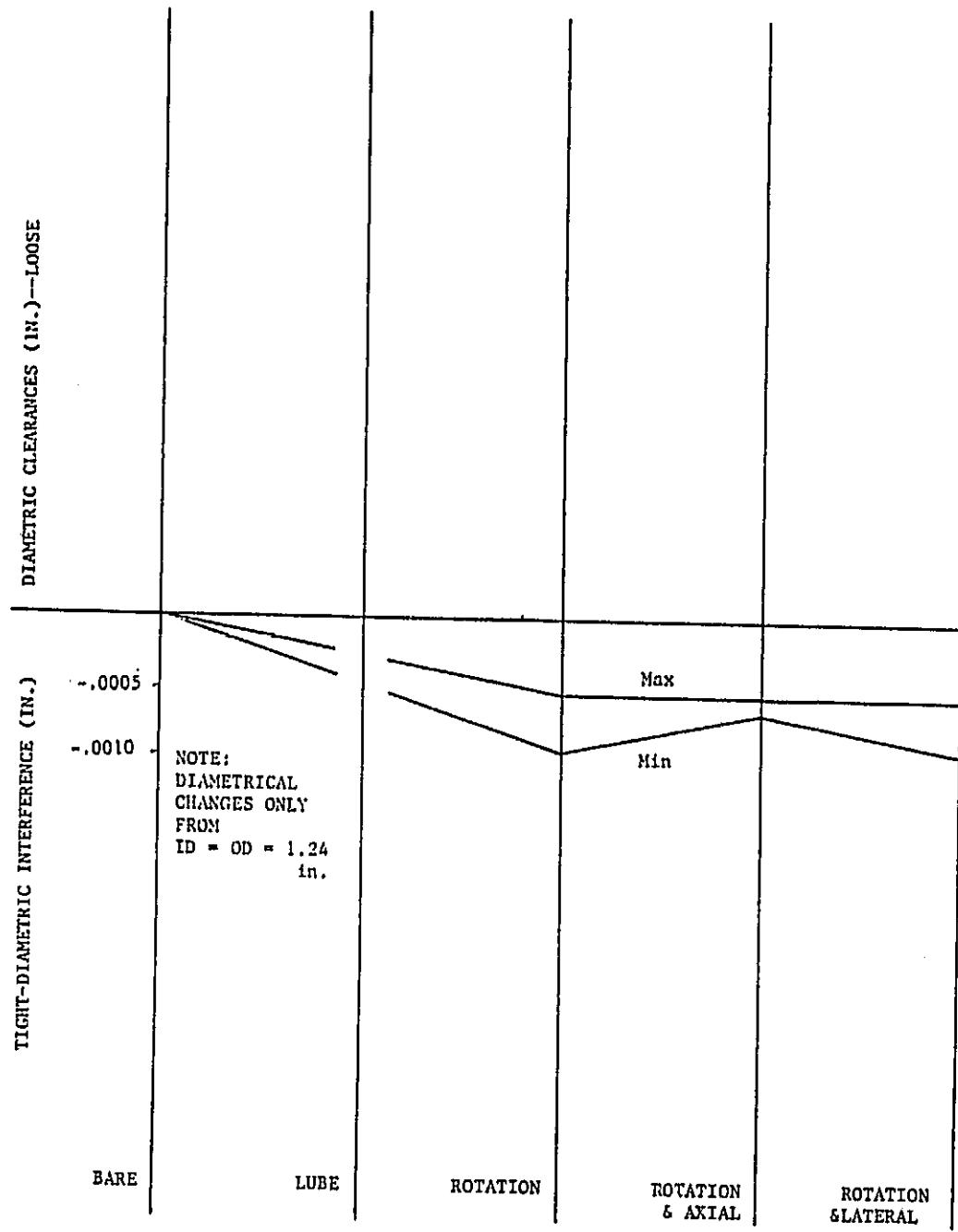


Fig. 12 Interface Fit Summary for Kel F Seal-to-Shaft Extension Plug (Point E)

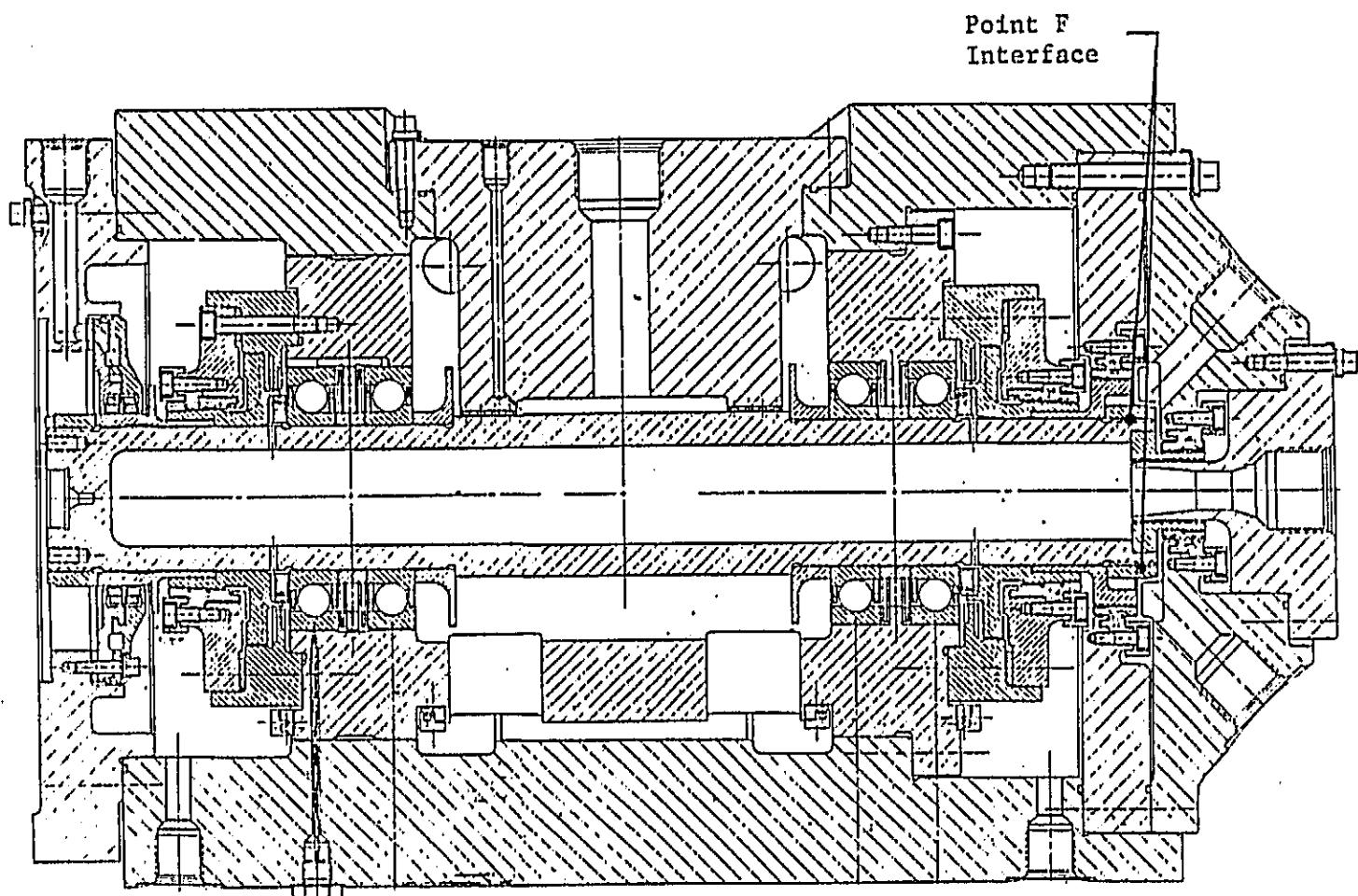


Fig. 13 K Monel Nut to Shaft

Table 7 K MONEL NUT (30A85244) TO SHAFT (30A85211), POINT F

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Nut i.d. Shaft o.d. Fit	2.1908 2.1733 <u>+.0175</u>	2.1738 2.1722 <u>+.0005</u>
2	Lube			
3	Rotation	Diametric Change Due to Rotation	<u>+.00005852</u>	<u>+.000008507</u>
4		Net Fit - Bare: 1 + 5	<u>+.017559</u>	<u>+.0005085</u>
5	Axial	Diametric Change Due to Axial	<u>-.0001351</u>	<u>-.0001943</u>
6		Net Fit - Bare: 1 + 7	<u>+.017365</u>	<u>+.0003057</u>
7	Lateral	Diametric Change Due to Lateral	<u>+.0000586</u>	<u>+.0000088</u>
8		Net Fit - Bare: 1 + 7	<u>+.017559</u>	<u>+.0005088</u>

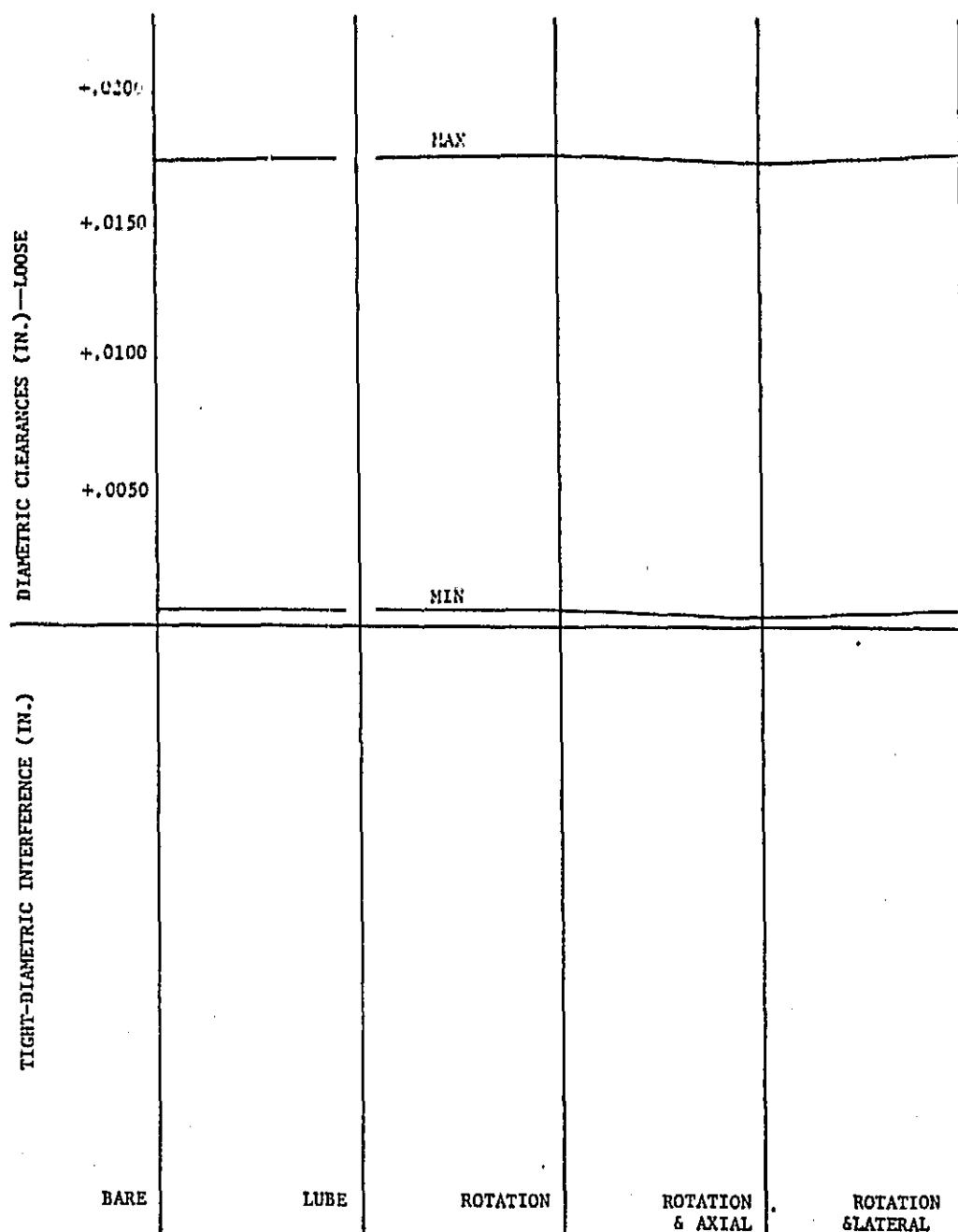


Fig. 14 Interface Fit Summary for K Monel Nut to Shaft (Point F)

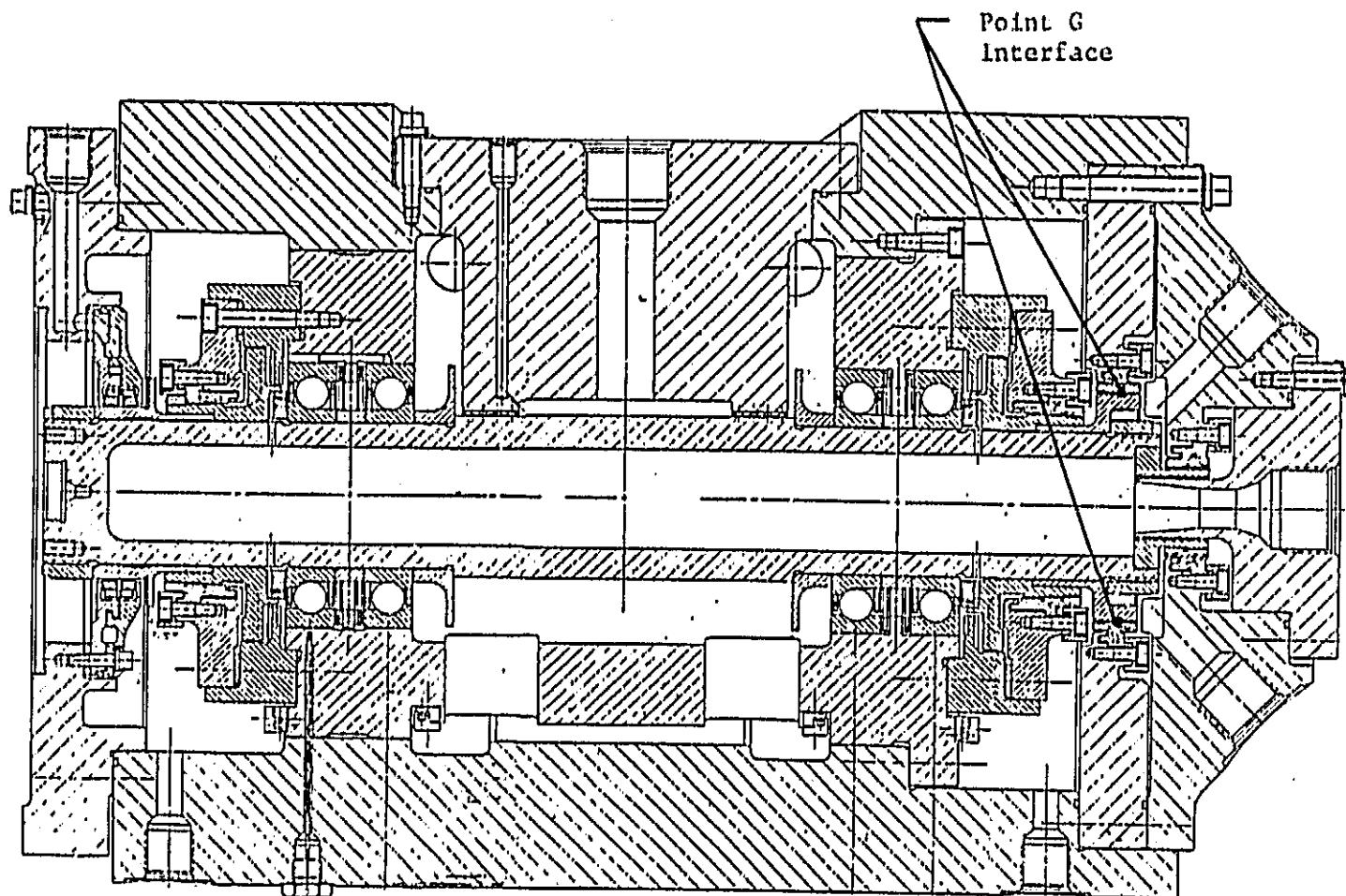


Fig. 15 Kel F Seal to Axial Labyrinth Seal

Table 8 KEL F LOAD CAVITY SEAL (30A85230)
 TO AXAIL LABYRINTH SEAL (30A85217)
 POINT G

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
	Bare (Model Diameter)	Interface Kel F Seal/Axial Seal	3.520	3.520
1		Kel F Seal i.d. Change	-.027373	-.028298
3	Rotation	Axial Seal o.d. Change	<u>-.006314</u>	<u>-.006461</u>
		Net Fit 1 - 2 = 3	<u>-.021059</u>	<u>-.021837</u>
4		Kel F Seal i.d. Change	-.022471	-.036179
5	Axial	Axial Seal o.d. Change	<u>-.0068089</u>	<u>-.0058214</u>
6		Net Fit 4 - 5 = 6	<u>-.02928</u>	<u>-.030358</u>
7		Kel F Seal i.d. Change	-.027374	-.0282954
	Lateral	Axial Seal o.d. Change	<u>-.0063144</u>	<u>-.0064613</u>
		Net Fit 7 - 8 = 9	<u>-.02106</u>	<u>-.021835</u>

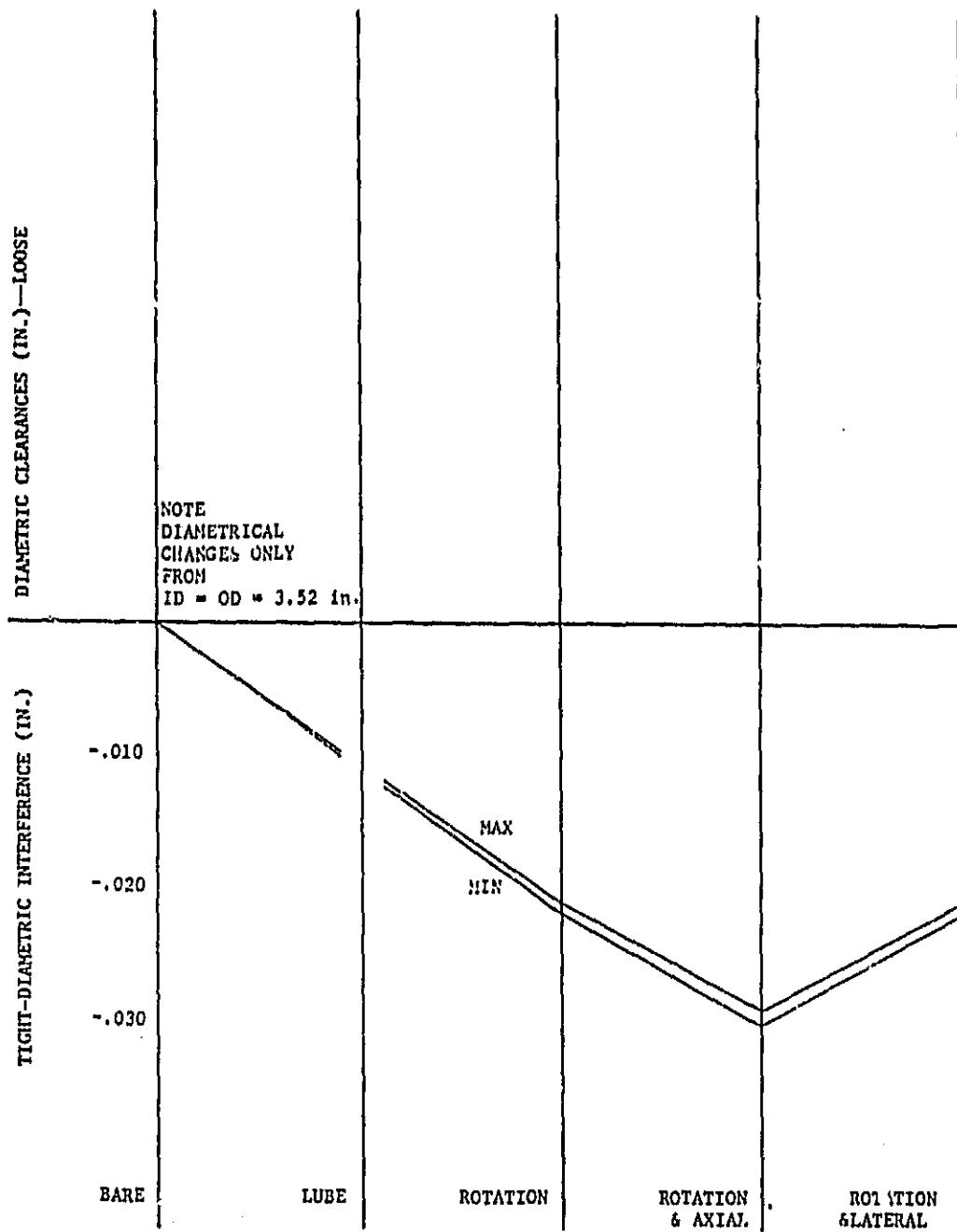


Fig. 16 Interface Fit Summary for Kel F Seal to Axial Labyrinth Seal (Point G)

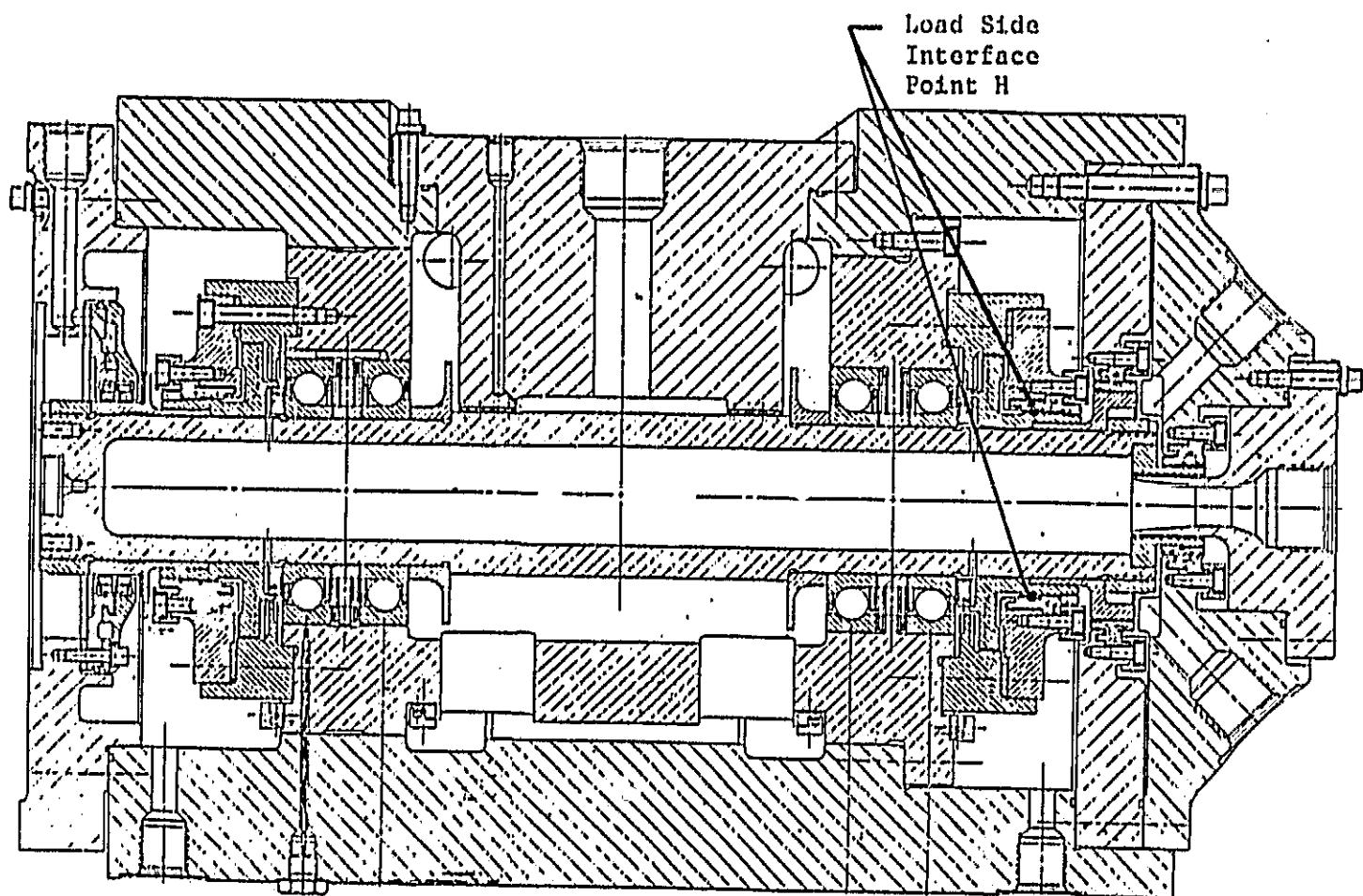


Fig. 17 Kel F Seal to Slinger (Load Side)

Table 9 KEL F SEAL (RS007921-007) TO LABYRINTH SEAL (30A85218)
LOAD SIDE, POINT H

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
	Bare (Model Diameter)	Interface Kel F Seal/Laby Seal	2.80	2.80
1		Kel F Seal i.d. Change	-.013416	-.015337
2	Rotation	Laby Seal o.d. Change	-.004487	-.005108
3		Net Fit 1 ~ 2 ~ 3	-.008929	-.010229
4		Kel F Seal i.d. Change	-.013492	-.015724
5	Axial	Laby Seal o.d. Change	-.004734	-.0056043
6		Net Fit 4 ~ 5 ~ 6	-.008758	-.01012
7		Kel F Seal i.d. Change	-.0131556	-.0139117
8	Lateral	Laby Seal o.d. Change	-.0048163	-.0039116
9		Net Fit 7 ~ 8 ~ 9	-.0083393	-.010000

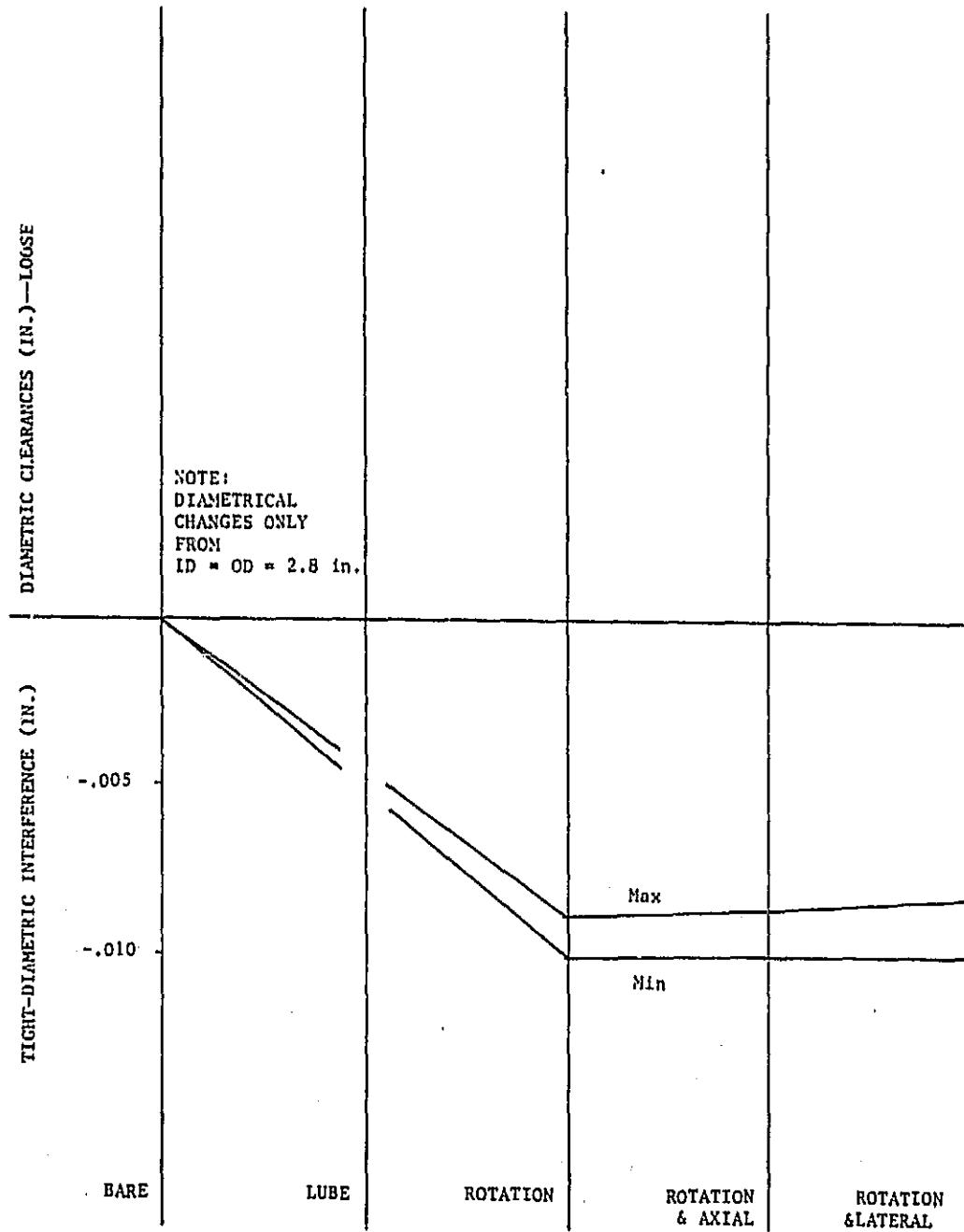


Fig. 18 Interface Fit Summary for Kel F Seal to Slinger
(Load Side Point H)

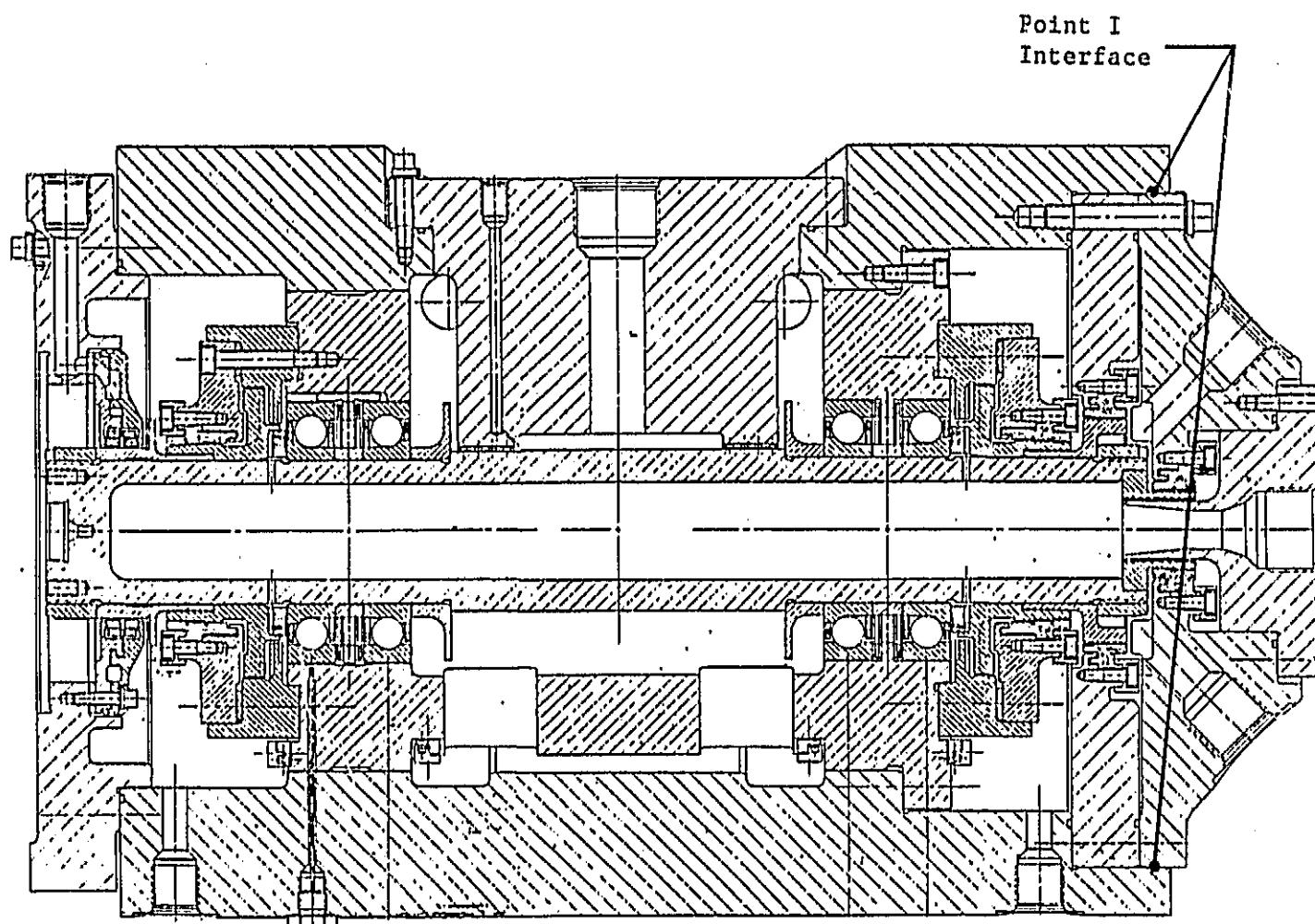


Fig. 19 Housing-to-Bulkhead Interface

Table 10 HOUSING (30A85210) TO BULKHEAD (30A85227),
(POINT I)

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Housing i.d.	10.5016	10.5008
		Bulkhead o.d.	<u>10.4992</u>	<u>10.500</u>
		Fit	<u>+.0024</u>	<u>+.0008</u>
2	Lube	Housing i.d.	10.5014	10.5004
		Bulkhead o.d.	<u>10.4994</u>	<u>10.5004</u>
		Fit	<u>+.0020</u>	<u>.0000</u>
3	Rotation	Diametric Change Due to Rotation	+.001994	+.001621
4		Net Fit Bare: 1 + 3 Lube: 2 + 3	<u>+.004394</u> (+.003994)	<u>+.002421</u> (+.001621)
5	Axial	Diam. Change Due to Axial	+.001785	+.0004593
6		Net Fit - Bare: 1 + 5 Lube: 2 + 5	<u>+.004185</u> (+.003785)	<u>+.001259</u> (+.0004593)
7	Lateral	Diametric Change Due to Lateral	+.002001	+.001603
8		Net Fit - Bare: 1 + 7 Lube: 2 + 7	<u>+.004401</u> (+.004001)	<u>+.002403</u> (+.001603)

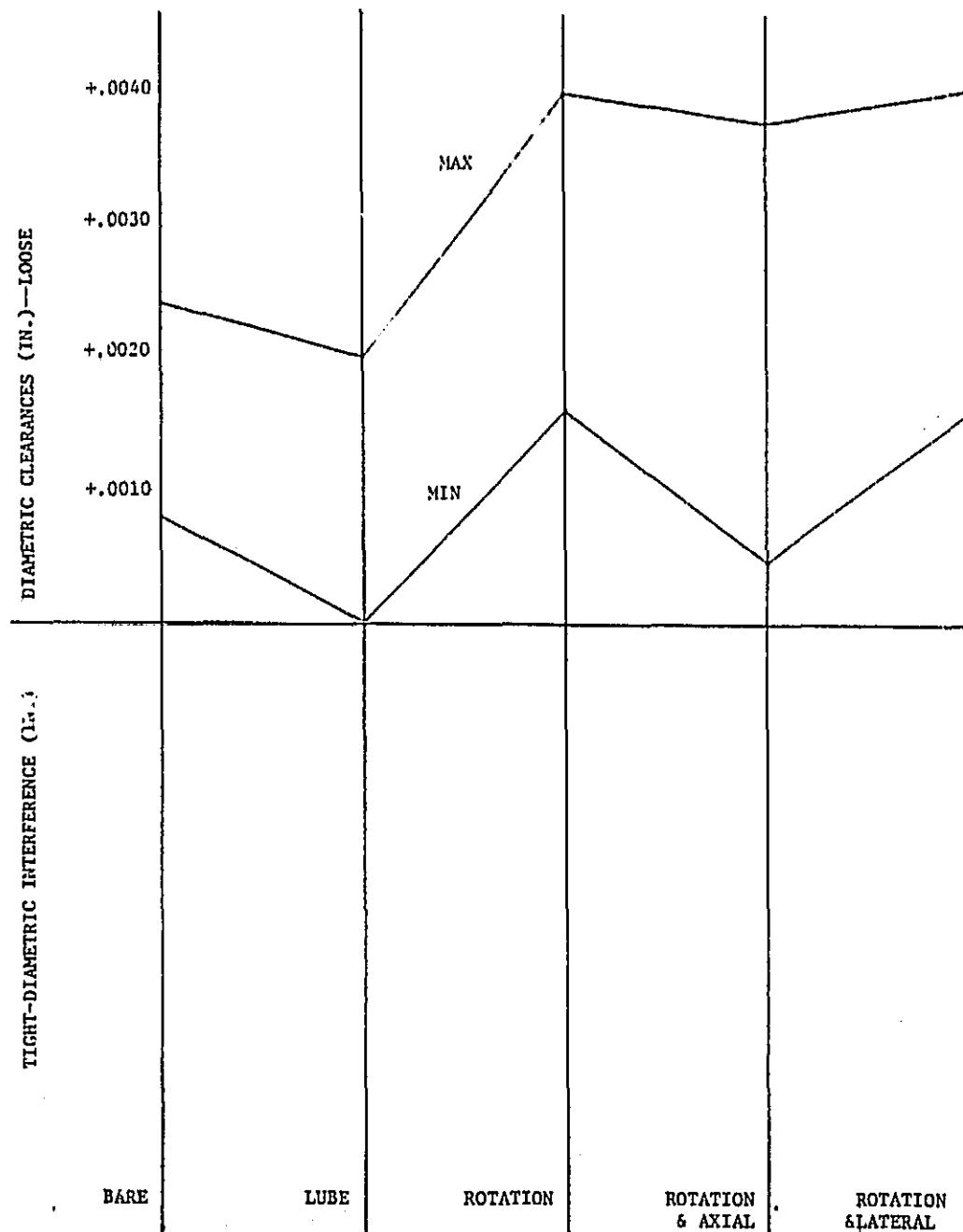


Fig. 20 Interface Fit Summary for Housing to Bulkhead
(Load End, Point I)

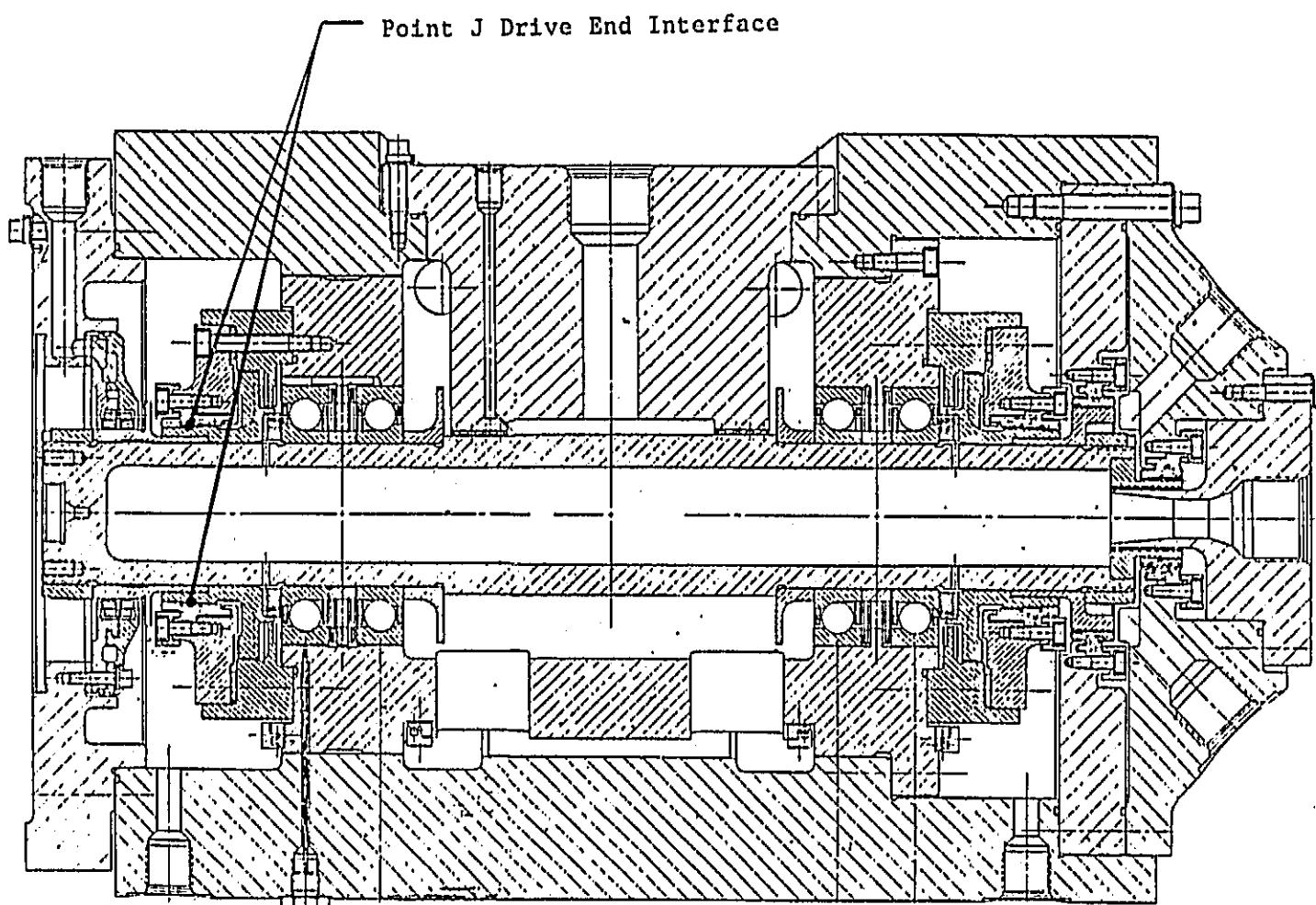


Fig. 21 Kel F Seal to Labyrinth Slinger (Drive Side)

Table 11 KEL F SEAL (RS007921-007) TO LABYRINTH SEAL (30A852L8)
(DRIVE END, POINT J)

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
	Bare (Model Diameter)	Interface - Kel F Seal/Laby Seal	2.80	2.80
1		Kel F Seal i.d. Change	-.037366	-.042754
2	Rotation	Laby Seal o.d. Change	-.004519	-.004612
3		Net Fit 1 - 2 = 3	-.032847	-.038142
4		Kel F Seal i.d. Change	-.037363	-.042758
5	Axial	Laby Seal o.d. Change	-.004519	-.004612
6		Net Fit 4 - 5 = 6	-.032843	-.038146
7		K F Seal i.d. Change	-.037364	-.042756
8	Lateral	Laby Seal o.d. Change	-.0045197	-.003688
9		Net Fit 7 - 8 = 9	-.0328443	-.039068

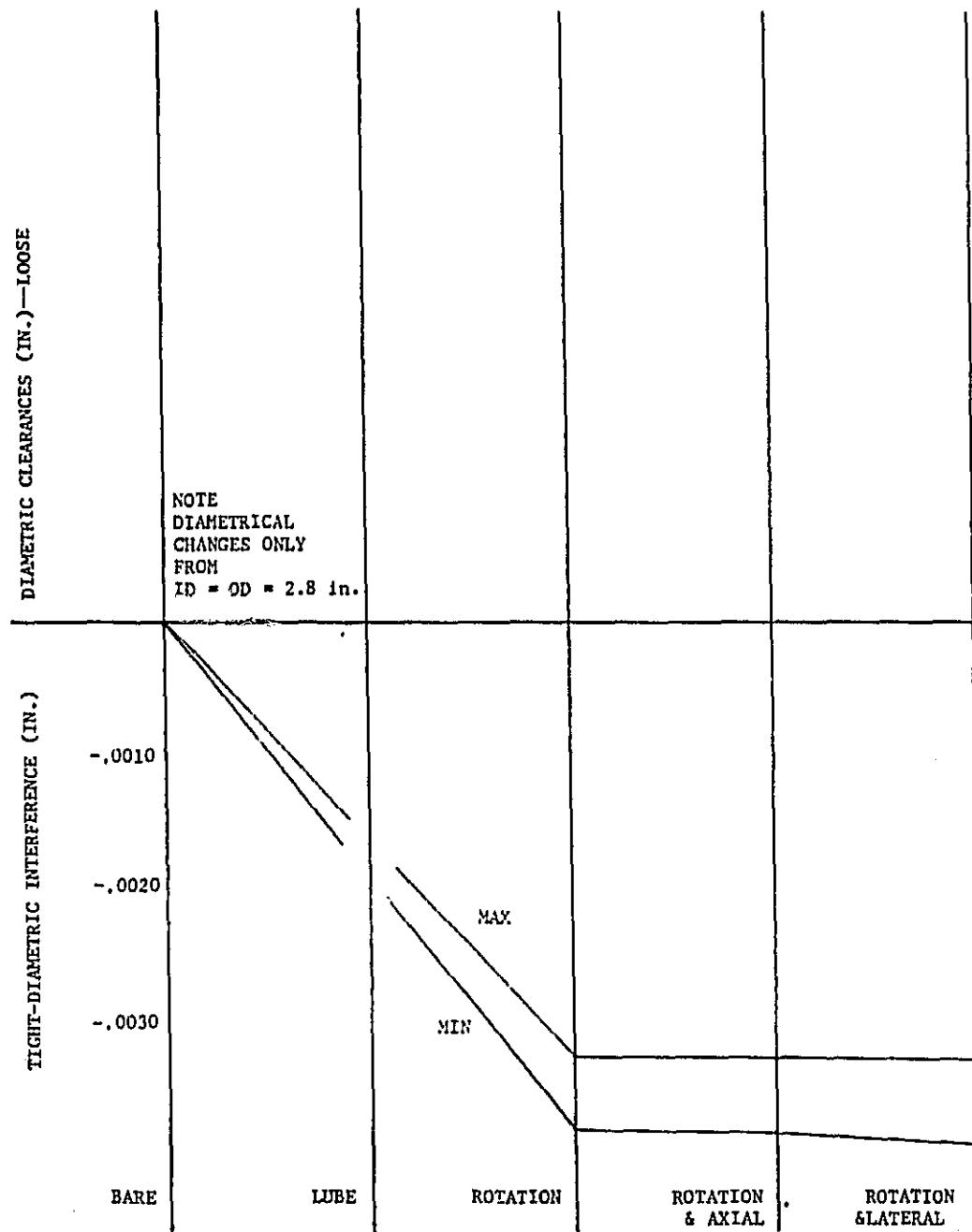


Fig. 22 Interface Fit Summary for Kel F Seal to Slinger
(Drive Side, Point J)

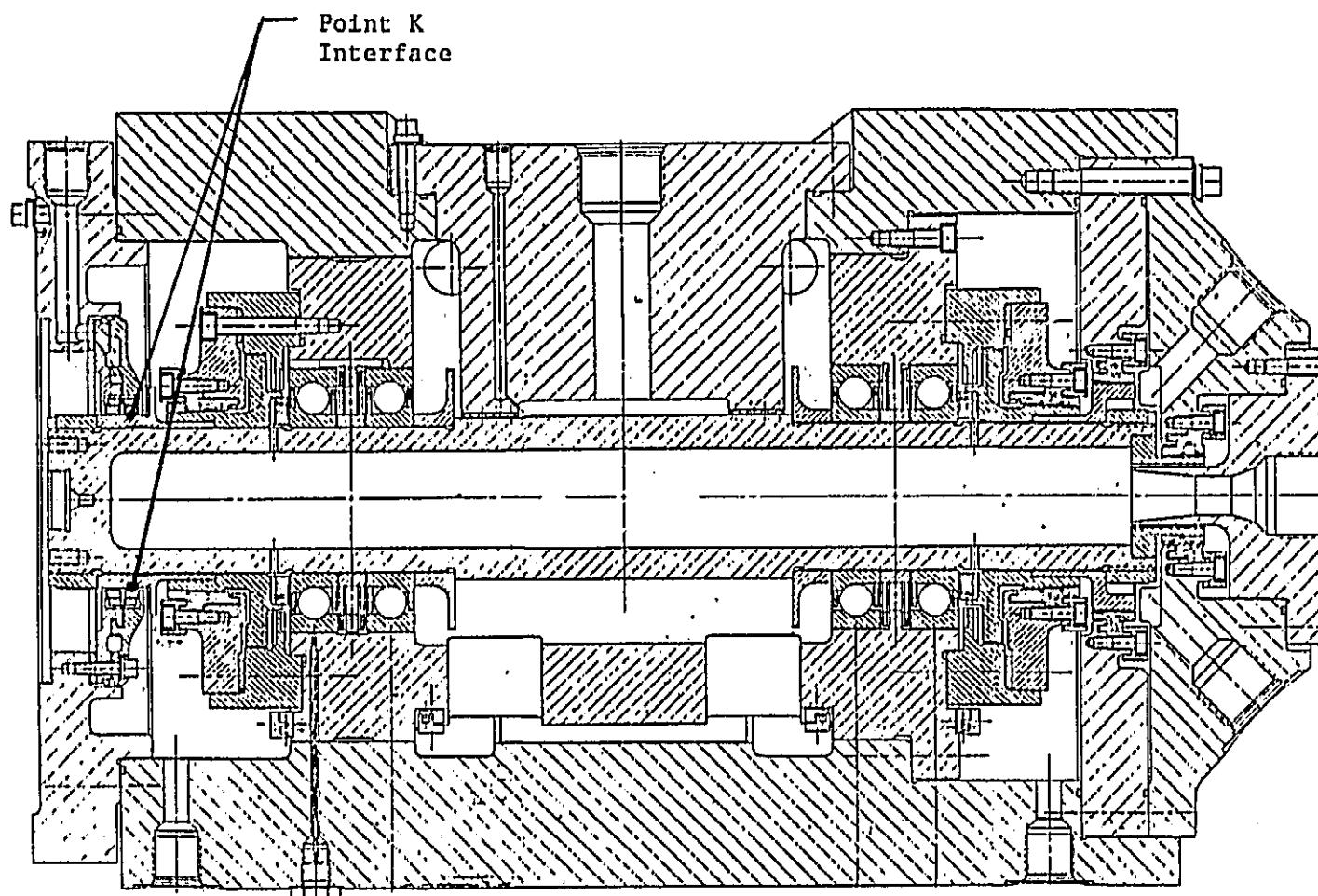


Fig. 23 Inco 718 Seal to Helium Seal (Point K)

Table 12 INCO 718 CARBON SEAL SLINGER (30A85216) TO HELIUM SEAL
POINT K

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
	Bare (Model Diameter)	Interface Carbon Seal/Helium Seal	1.34	1.34
1	Rotation	Helium Seal i.d. Change	-.0009406	-.0007191
2		Carbon Seal o.d. Change	-.0014559	-.0001191
3		Net Fit 1 - 2 = 3	+.0005153	-.000600
4	Axial	Helium Seal i.d. Change	-.0009413	-.0006928
5		Carbon Seal o.d. Change	-.0014559	-.000093
6		Net Fit 4 - 5 = 6	+.0005146	-.0005998
7	Lateral	Helium Seal i.d. Change	+.002739	+.0006919
8		Carbon Seal o.d. Change	-.0012125	-.000093
9		Net Fit 7 - 8 = 9	+.0039515	+.0007848

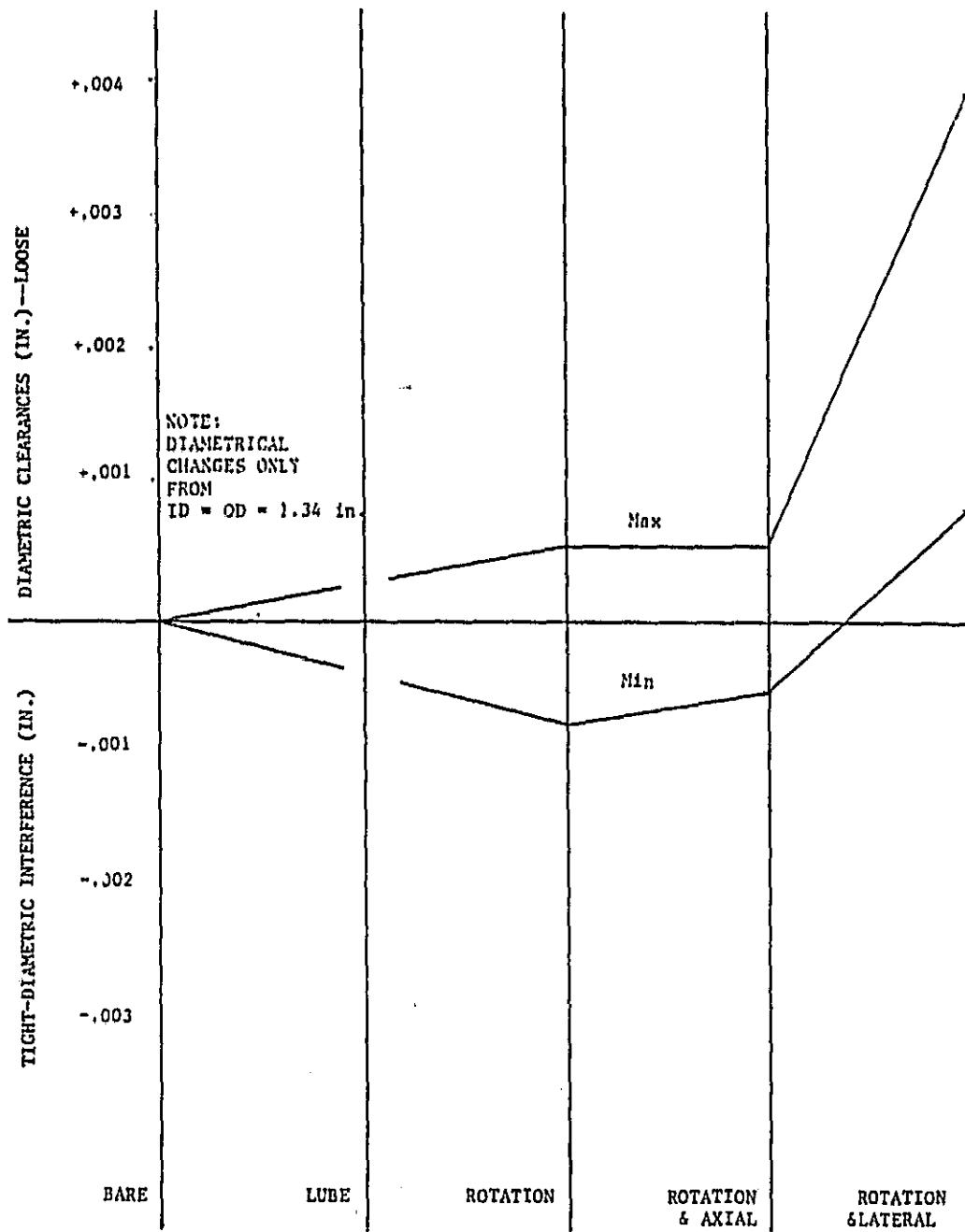


Fig. 24 Interface Fit Summary for Inco 718 Seal to Helium Seal (Point K)

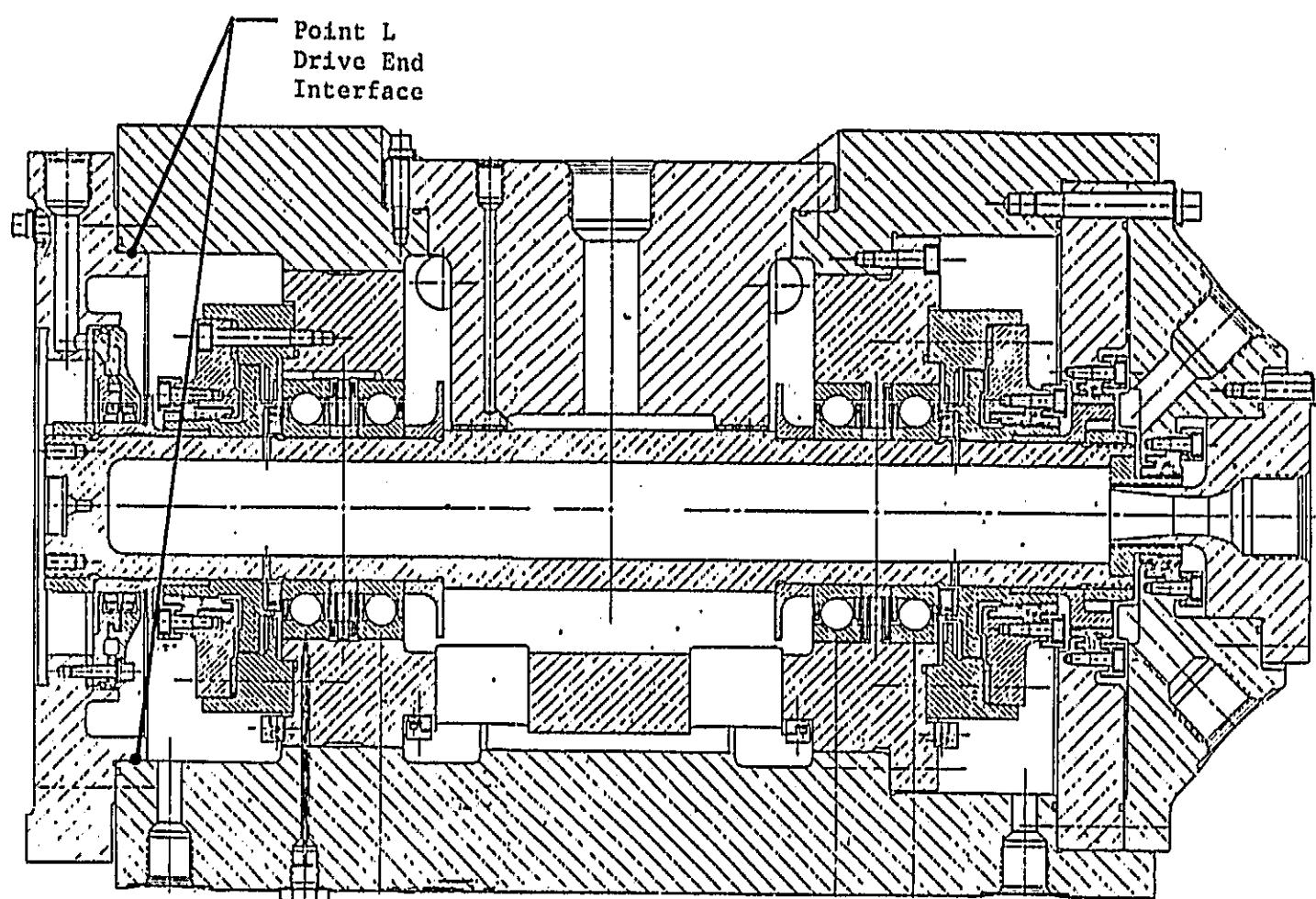


Fig. 25 Housing-to-Bulkhead Interface

Table 13 HOUSING-TO-BULKHEAD DRIVE END, POINT L

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Housing i.d.	8.0013	8.0006
		Bulkhead o.d.	7.9993	8.0000
		Fit	<u>+.0020</u>	<u>+.0006</u>
2	Lube	Housing i.d.	8.0011	8.0002
		Bulkhead o.d.	7.9995	8.0004
		Fit	<u>+.0016</u>	<u>-.0002</u>
3	Rotation	Diametric Change Due to Rotation	-.00005141	-.0008469
4		Net Fit - Bare: 1 + 3 Lube: 2 + 3	<u>+.0019486</u> (+.0015486)	<u>-.0002469</u> (-.0010469)
5	Axial	Diam Change Due to Axial	-.0000806	-.0009098
6		Net Fit - Bare: 1 + 5 Lube: 2 + 5	<u>+.0019194</u> (+.0015194)	<u>-.0003098</u> (-.0011098)
7	Lateral	Diam Change Due to Lateral	-.00004678	-.0008454
8		Lateral Net Fit - Bare: 1 + 7 Lube: 2 + 7	<u>+.0019532</u> (+.0015532)	<u>-.0002454</u> (-.0010545)

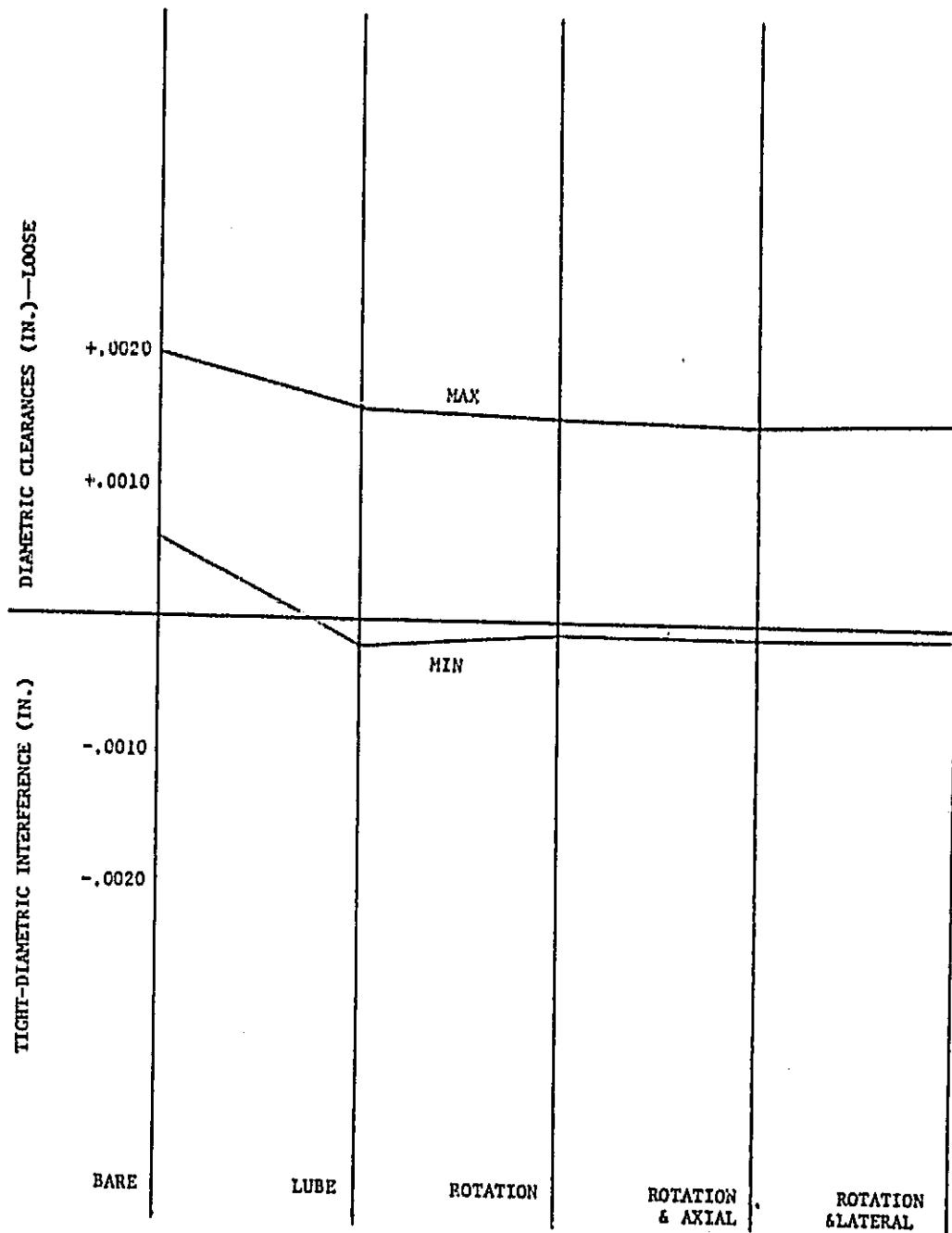


Fig. 26 Interface Fit Summary for Housing to Bulkhead
(Drive End, Point L)

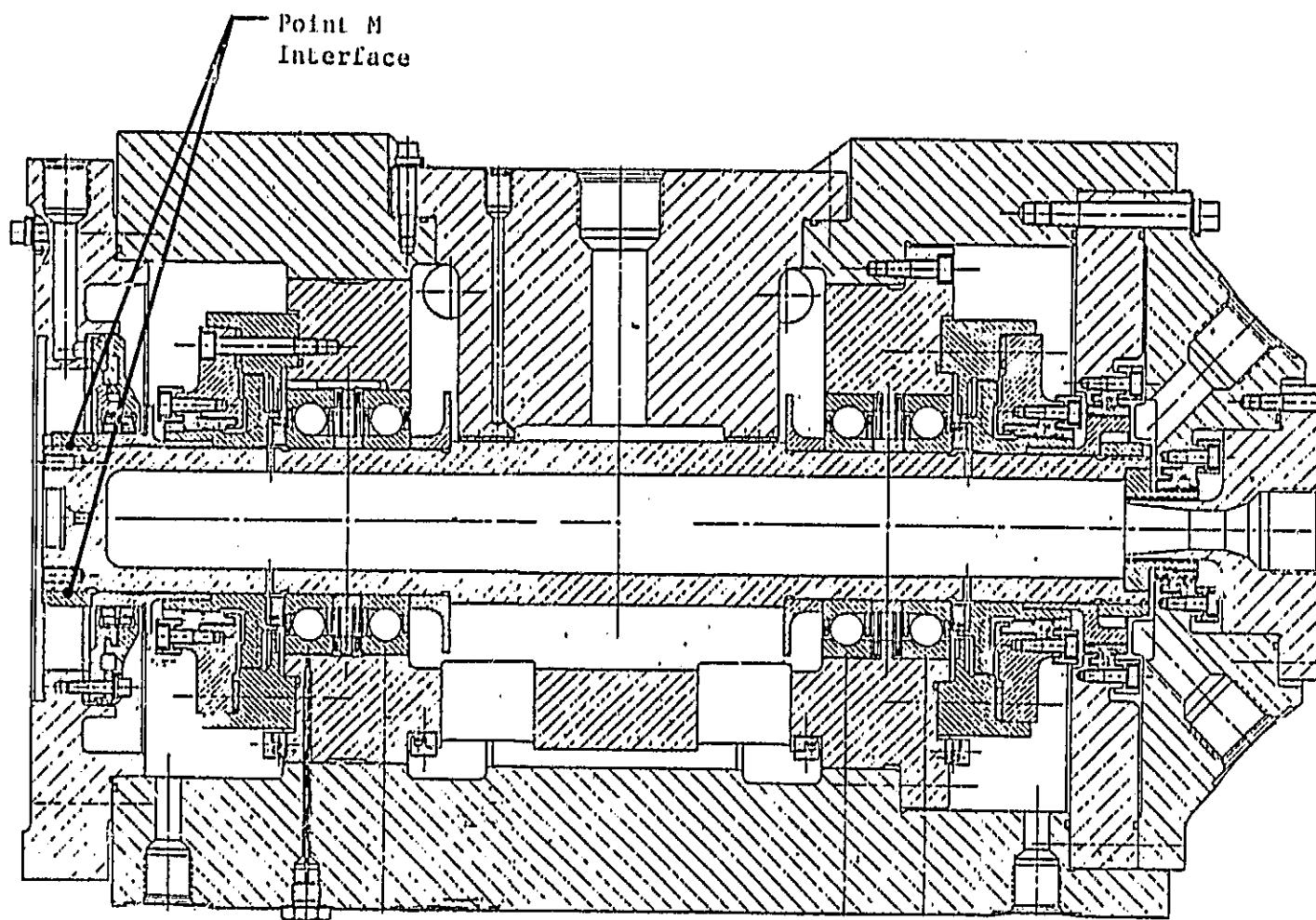


Fig. 27 K Monel Nut to Shaft

Table 14 K MONEL NUT (30A85244) TO SHAFT (30A85271)
POINT M

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Nut i.d. Shaft o.d. Fit	2.1908 2.1733 +.0175	2.1738 2.1733 +.0005
2	Lube			
3	Rotation	Diametric Change Due to Rotation	+.003183	+.0007746
4		Net Fit - Bare: 1 + 3	+.020683	+.0012746
5	Axial	Diametric Change Due to Axial	+.003183	+.0007746
6		Net Fit - Bare: 1 + 5	+.020683	+.0012746
7	Lateral	Diametric Change Due to Lateral	+.003183	+.0007746
8		Net Fit - Bare: 1 + 7	+.020683	+.0012746

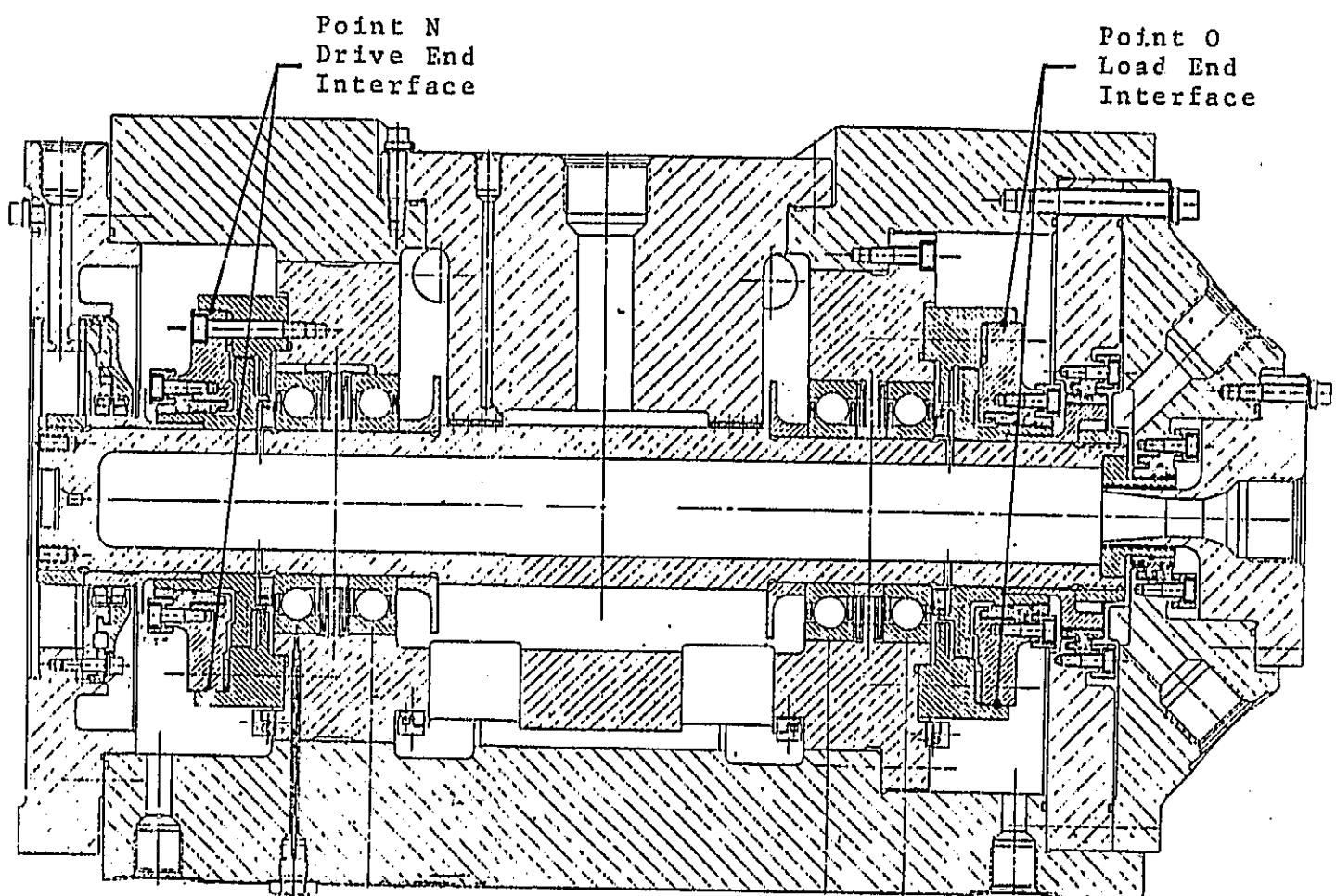


Fig. 29 Seal Support-to-Seal Carrier

Table 15 SEAL SUPPORT (30A85215) TO SEAL CARRIER (30a852L4)
DRIVE SIDE, POINT N

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare:	Seal Support i.d.	5.9387	5.9381
		Seal Carrier o.d.	5.9369	5.9375
		Fit	+.0018	+.0006
2	Lube	Seal Support i.d.	5.9385	5.9377
		Seal Carrier o.d.	5.9371	5.9379
		Fit	+.0014	-.0002
3	Rotation	Diametric Change Due to Rotation	+.0000923	-.0000895
4		Net Fit - Bare: 1 + 3 Lube: 2 + 3	+.0018923 +.0014923	+.0005105 -.0002895
5	Axial	Diam Change Due to Axial	+.0000933	-.0000915
6		Net Fit - Bare: 1 + 5 Lube: 2 + 5	+.0018933 +.0014933	+.0005085 -.0002915
7	Lateral	Diam Change Due to Lateral	+.0000932	-.0001208
8		Net Fit - Bare: 1 + 7	+.0018932	+.0004792
8		Net Fit - Lube: 2 + 7	(+.0014932)	(-.0003208)

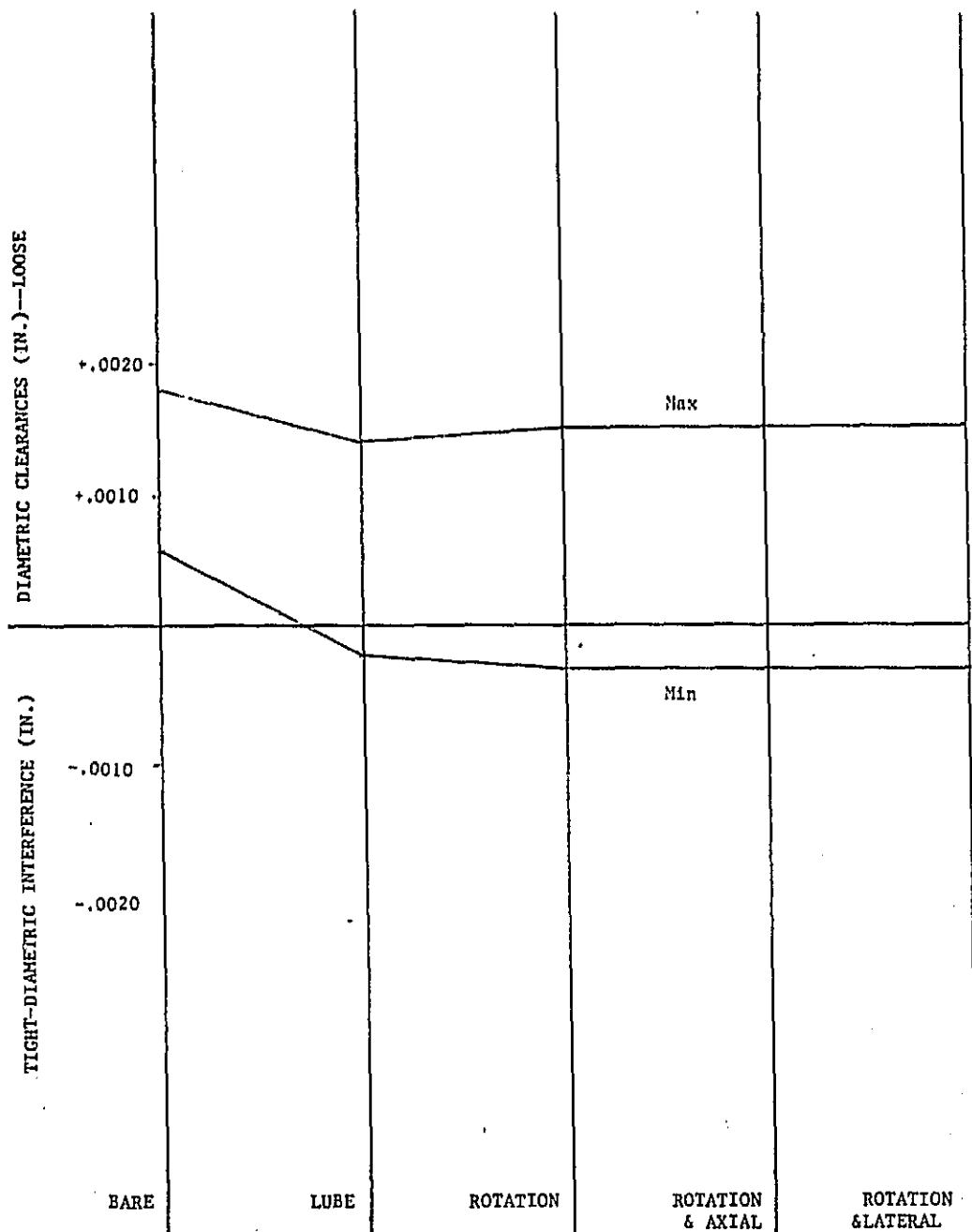


Fig. 30 Interface Fit Summary for Seal Support-to-Seal Carrier
(Drive Side, Point N)

Table 16 SEAL SUPPORT (30A85215) TO SEAL CARRIER (30A85214)
LOAD SIDE, POINT 0

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Seal Support i.d.	5.9387	5.9381
		Seal Carrier o.d.	5.9369	5.9375
		Fit	+.0018	+.0006
2	Lube	Seal Support i.d.	5.9385	5.9377
		Seal Carrier o.d.	5.9371	5.9379
		Fit	+.0014	-.0002
3	Rotation	Diametric Change Due Rotation	+.0001742	-.0006417
4		Net Fit - Bare: 1 + 3	+.0019742	-.0000417
		Lube: 2 + 3	(+.0015742)	(-.0008417)
5	Axial	Diametric Change Due to Axial	-.0000294	-.0005585
6		Net Fit - Bare: 1 + 5	+.0017706	+.0000415
6		Lube: 2 + 5	(+.0013706)	(-.0007585)
7	Lateral	Diametric Change Due to Lateral	+.0000949	-.000549
8		Net Fit - Bare: 1 + 7	+.0018949	+.000051
		Lube: 2 + 7	(+.0014949)	(-.000749)

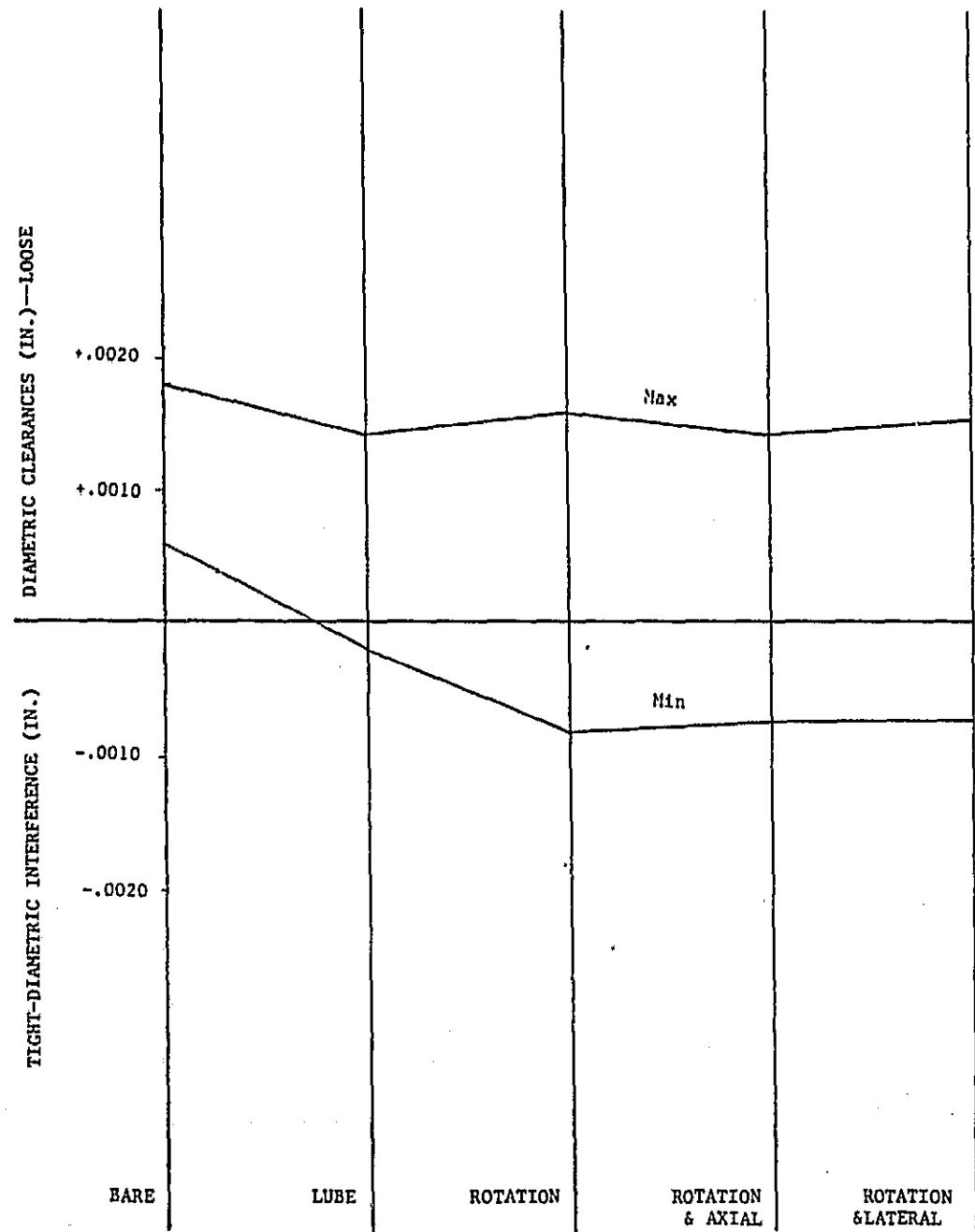


Fig. 31 Interface Fit Summary for Seal Support-to-Seal Carrier (Load Side, Point 0)

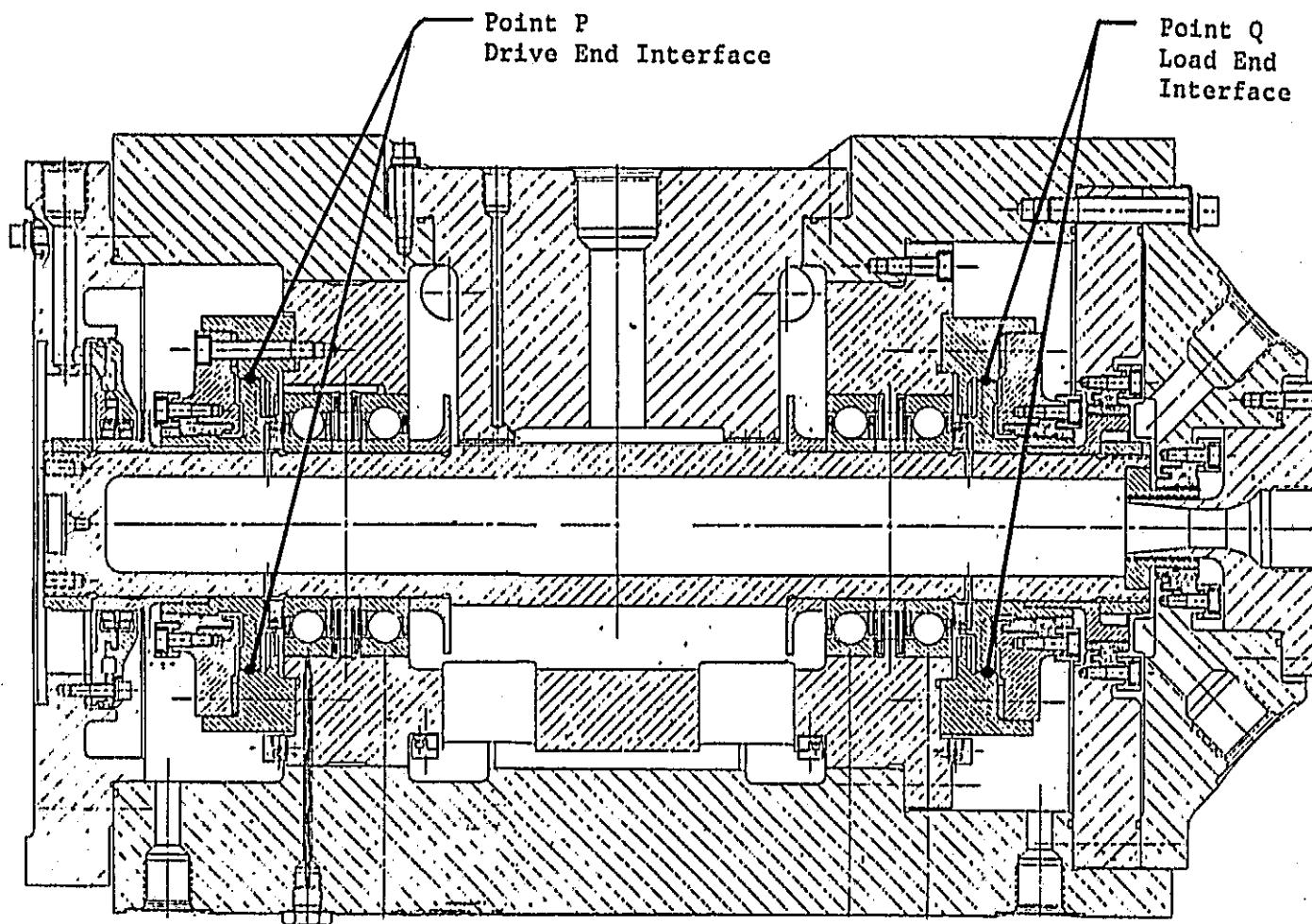


Fig. 32 Seal Support-to-Labyrinth Seal

Table 17 SEAL SUPPORT (30A85215) TO LABYRINTH SEAL (30A85218)
DRIVE SIDE, POINT P

SL No.	Load Case	Detail	Diametric Fit Max.	Diametric Fit Min.
		Seal Support i.d.	4.521	4.520
		Laby Seal o.d.	4.478	4.480
1	Bare		<u>+.043</u>	<u>+.040</u>
2	Lube			
3	Rotation	Diametric Change Due To Rotation	-.001550	-.001939
4		Net Fit - 1 + 3	+.041450	+.038060
5	Axial	Diametric Change Due to Axial	-.001551	-.001916
6		Net Fit - Bare: 1 + 3	+.041449	+.038084
7	Lateral	Diam Change Due to Lateral	-.001550	-.001916
8		Net Fit - Bare: 1 + 7	+.04145	+.038084

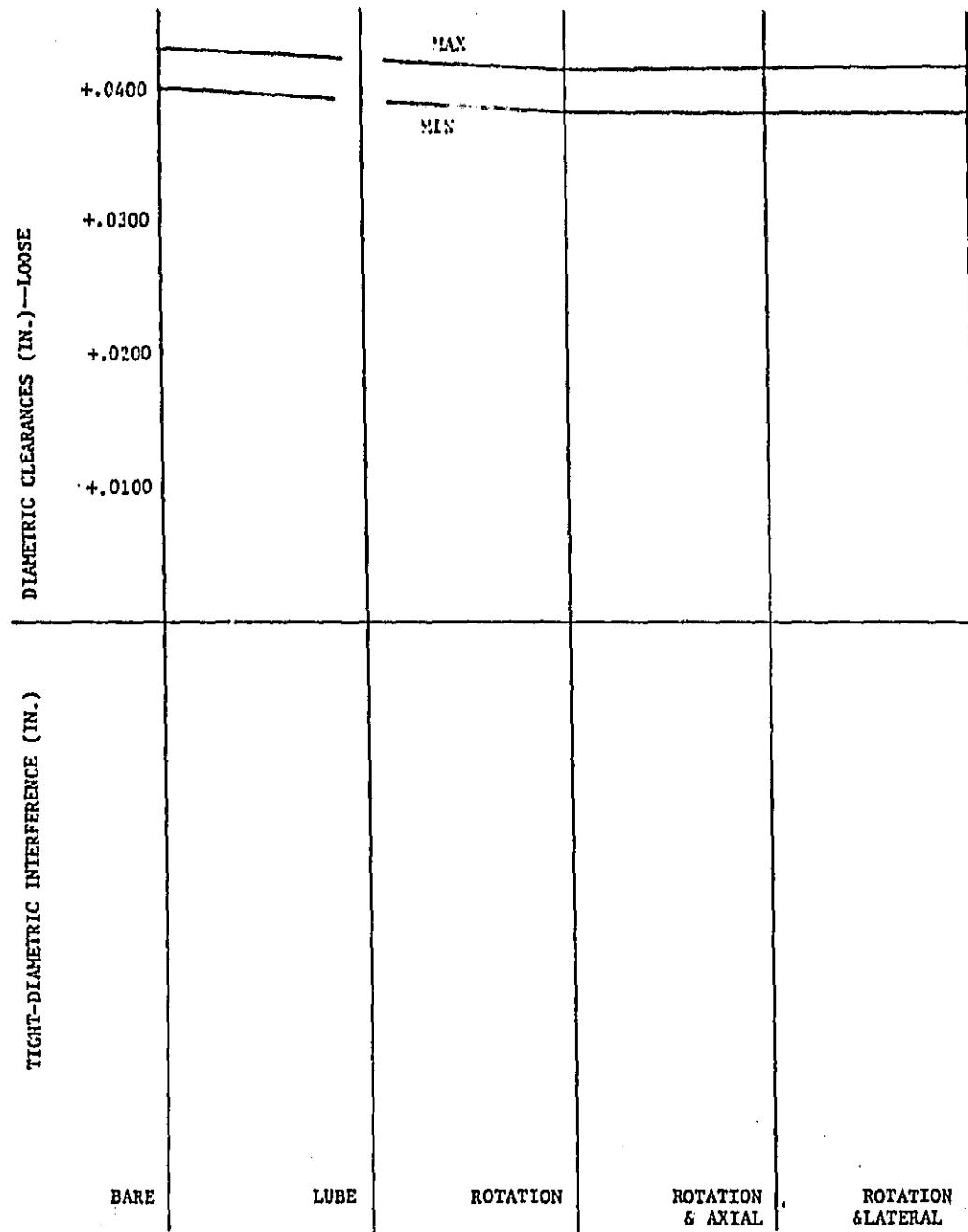


Fig. 33 Interface Fit Summary for Seal Support to Slinger
(Drive Side, Point P)

Table 18 SEAL SUPPORT (30A85215) TO LABYRINTH SEAL (30A85218)
LOAD SIDE, POINT Q

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Seal Support i.d.	4.521	4.520
		Laby Seal o.d.	4.478	4.480
		Fit	+.043	+.040
2	Lube	Seal Support i.d.		
		Laby Seal o.d.		
		Fit		
3	Rotation	Diam. change Due to Rotation	-.001413	-.002047
4		Net Fit - Bare: 1 + 3	+.04159	+.037953
		Lube: 2 + 3		
5	Axial	Diametric Change Due to	-.001669	-.002110
6		Net Fit - Bare: 1 + 5	+.041331	+.03789
		Lube: 2 + 5		
7	Lateral	Diametric Change Due to Lateral	-.001424	-.002049
8		Net Fit - Bare: 1 + 7	+.041576	+.037951
		Lube: 2 + 7		

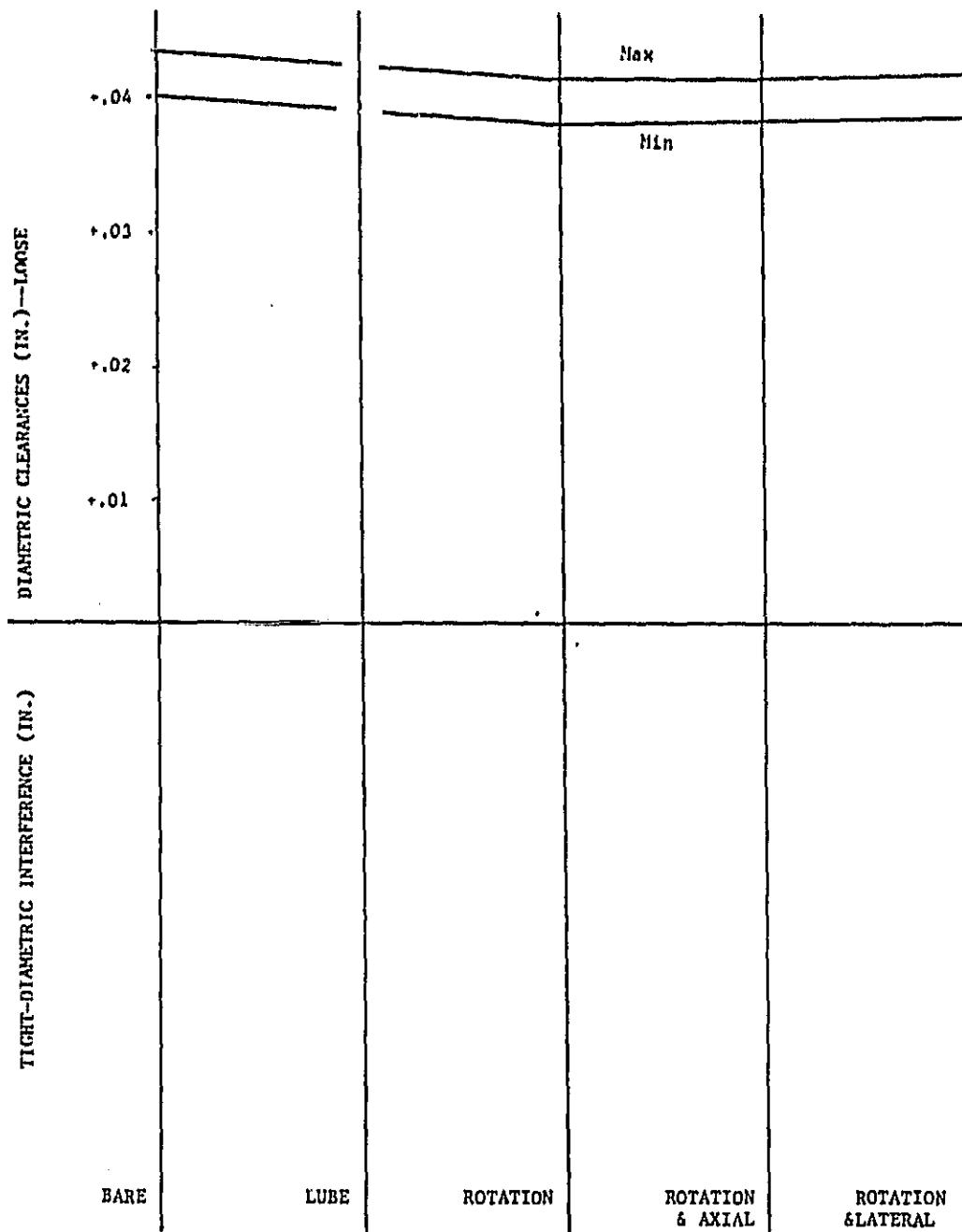


Fig. 34 Interface Fit Summary for Seal Support to Slinger
(Load Side, Point Q)

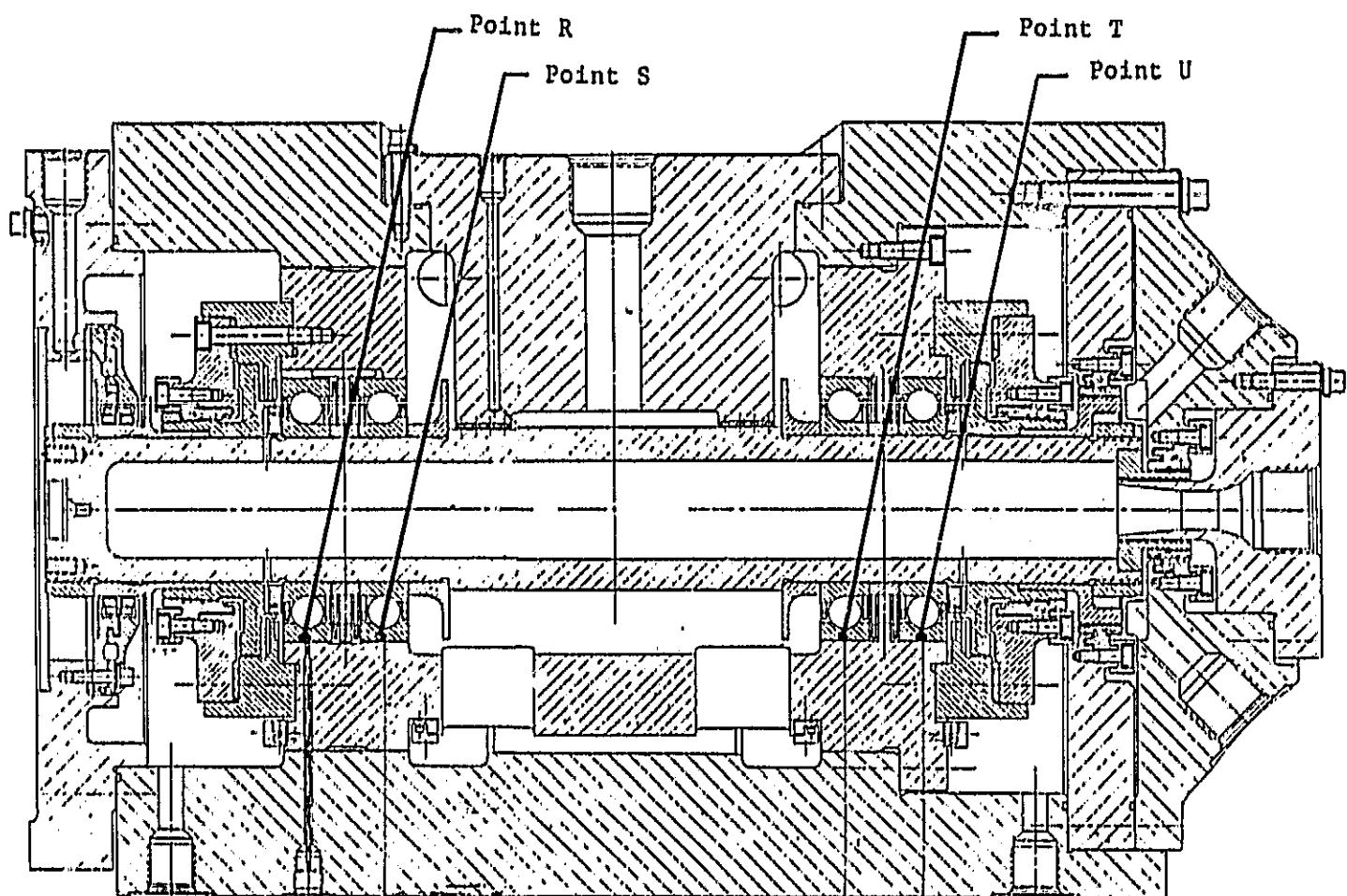


Fig. 35 Bearing Carrier to Bearing Interface

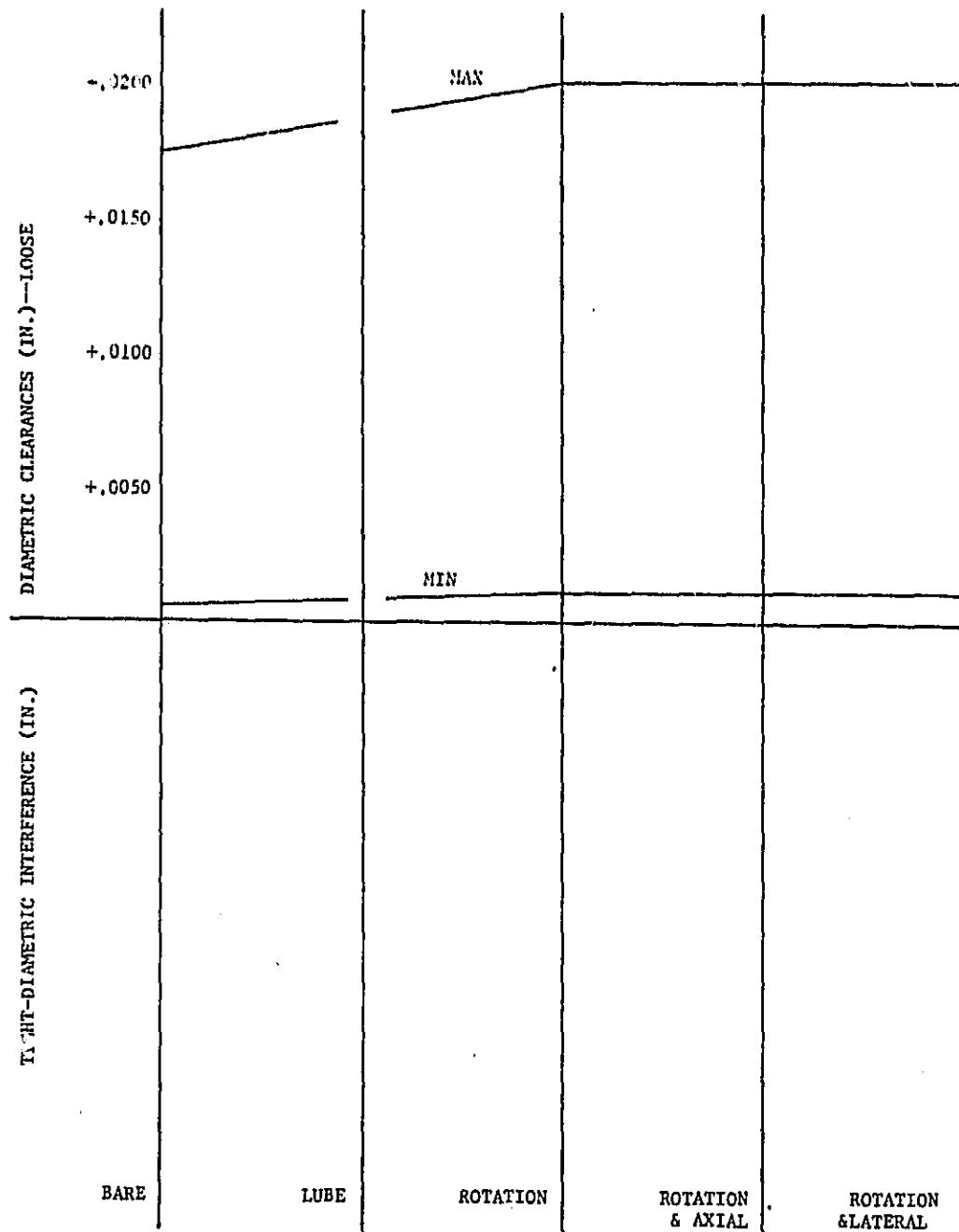


Fig. 28 Interface Fit Summary for K Monel Nut to Shaft
(Drive Side, Point M)

Table 19 BEARING CARRIER (30A85208) TO BEARING 1 (RS007955-091)
POINT R

SL No.	Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Carrier i.d.	4.0636	4.0631
		Bearing o.d.	4.0597	4.0600
		Fit	<u>+.0039</u>	<u>+.0031</u>
2	Lube	Carrier i.d.	4.0634	4.0627
		Bearing o.d.	4.0599	4.0604
		Fit	<u>+.0035</u>	<u>+.0023</u>
3	Rotation	Diametric Change Due to Rotation	-.001768	-.002054
4		Net Fit - Bare: 1 + 3	<u>+.002132</u>	<u>-.001046</u>
		Lube: 2 + 3	(+.001732)	(+.000246)
5	Axial	Diametric Change Due to Axial	-.001774	-.002054
6		Net Fit - Bare: 1 + 5	<u>+.002126</u>	<u>+.001046</u>
		Lube: 2 + 5	(+.001726)	(+.000246)
7	Lateral	Diametric Change Due to Lateral	-.001771	-.002050
8		Net Fit - Bare: 1 + 7	<u>+.002129</u>	<u>+.00105</u>
		Lube: 2 + 7	(+.001729)	(+.00025)

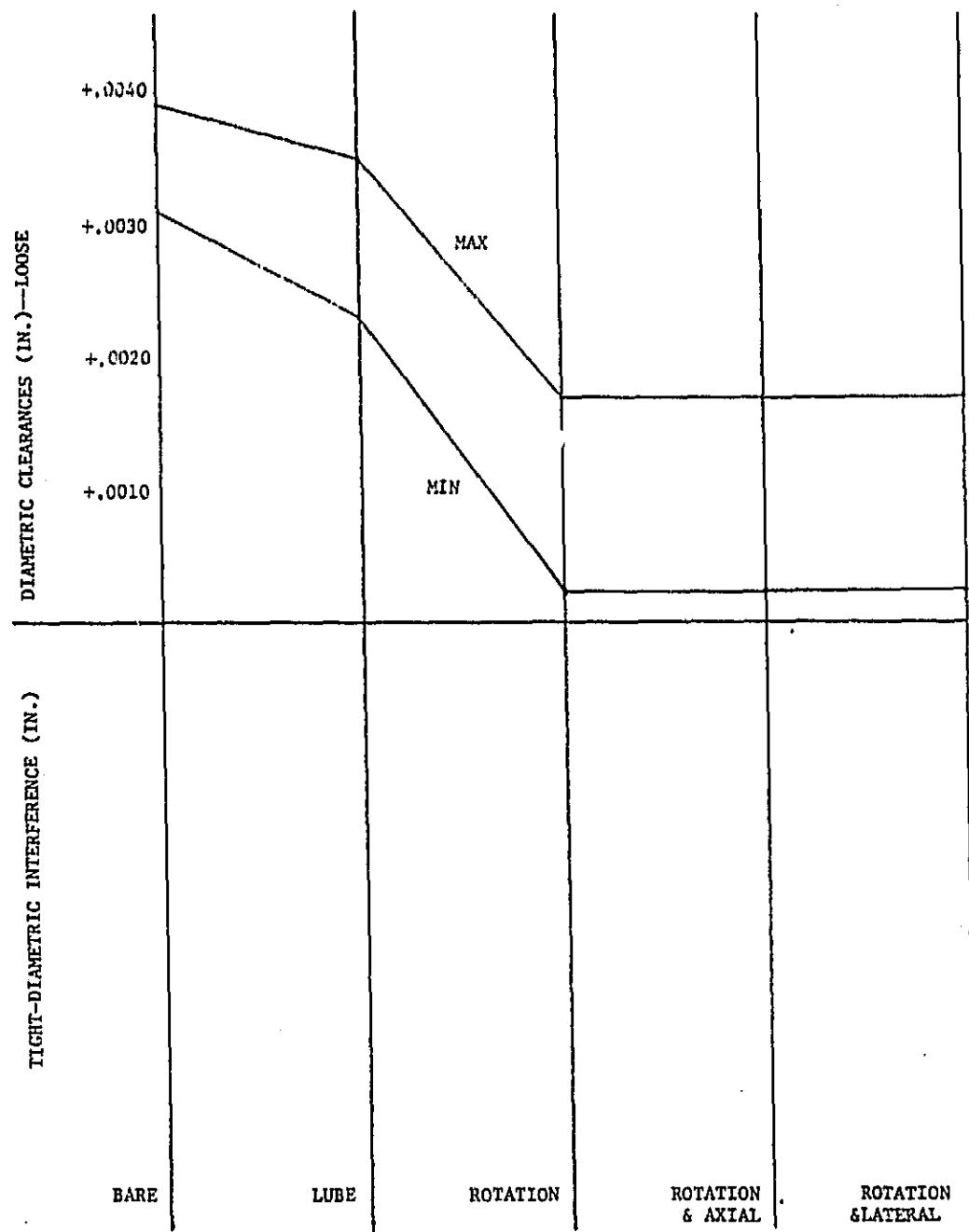


Fig. 36 Interface Fit Summary for Bearing Carrier to Race 1
(Drive Side, Point R)

Table 20 BEARING CARRIER (30A85208) TO BEARING 2 (RS007955-091)
POINT S

SL No.	Load Case	Detail	Diametric Fit Max.	Diametric Fit Min.
1	Bare	Carrier i.d.	4.0636	4.0631
		Bearing o.d.	4.0597	4.0600
		Fit	<u>+.0039</u>	<u>+.0031</u>
2	Lube	Carrier i.d.	4.0634	4.0627
		Bearing o.d.	4.0599	4.0604
		Fit	<u>+.0035</u>	<u>+.0023</u>
3	Rotation	Diametric Change Due to Rotation	-.002019	-.002330
4		Net Fit - Bare: 1 + 3 Lube: 2 + 3	<u>+.001881</u> (+.001481)	<u>+.00077</u> (-.00003)
5	Axial	Diametric Change Due to Axial	-.002008	-.002319
6		Net Fit - Bare: 1 + 5 Lube: 2 + 5	<u>+.001892</u> (+.001492)	<u>+.000781</u> (-.000019)
7		Diametric Change Due to Lateral	-.002014	-.002327
8	Lateral	Net Fit - Bare: 1 + 7 Lube 2 + 7	<u>+.001886</u> (+.001486)	<u>+.000773</u> (-.000027)

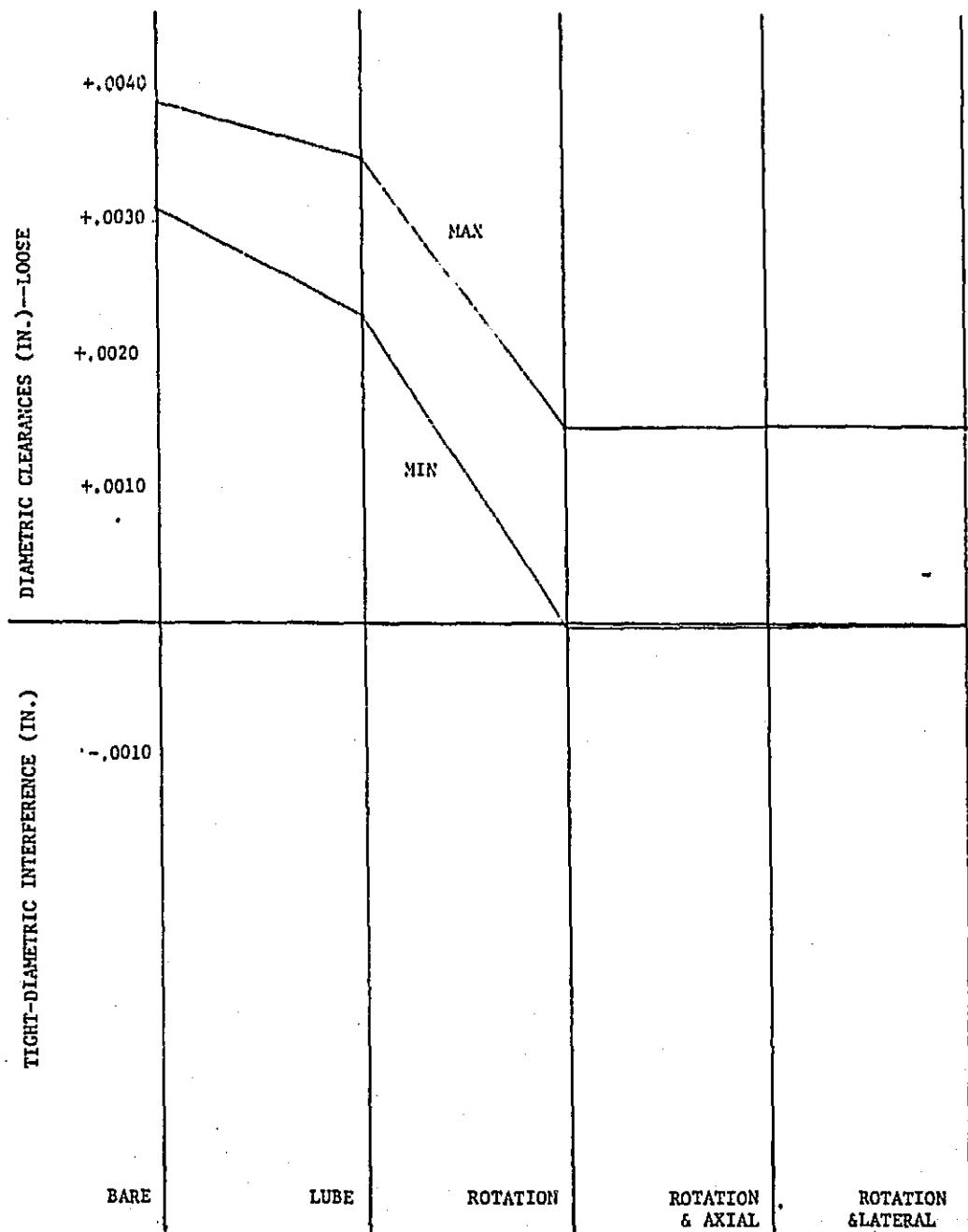


Fig. 37 Interface Fit Summary for Bearing Carrier to Race 2
(Drive Side, Point S)

Table 21 BEARING CARRIER (30A85208) TO BEARING 3 (RS007955-091)
POINT T

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Carrier i.d.	4.0636	4.0631
		Bearing o.d.	4.0597	4.0600
		Fit	+.0039	+.0031
2	Lube	Bearing i.d.	4.0634	4.0627
		Bearing o.d.	4.0599	4.0604
		Fit	+.0035	+.0023
3	Rotation	Diametric Change Due to Rotation	-.001917	-.003480
4		Net Fit Bare: 1 + 3 Lube: 2 + 3	+.001983 (+.001583)	-.00038 (-.00118)
5	Axial	Diametric Change Due to Axial	-.001934	-.003364
6		Net Fit - Bare: 1 + 5 Lube: 2 + 5	+.001966 (+.001566)	-.000264 (-.001064)
7	Lateral	Diametric Change Due to Lateral	-.001871	-.003291
8		Net Fit - Bare: 1 + 7 Lube: 2 + 7	+.002029 (+.001629)	-.000191 (-.000991)

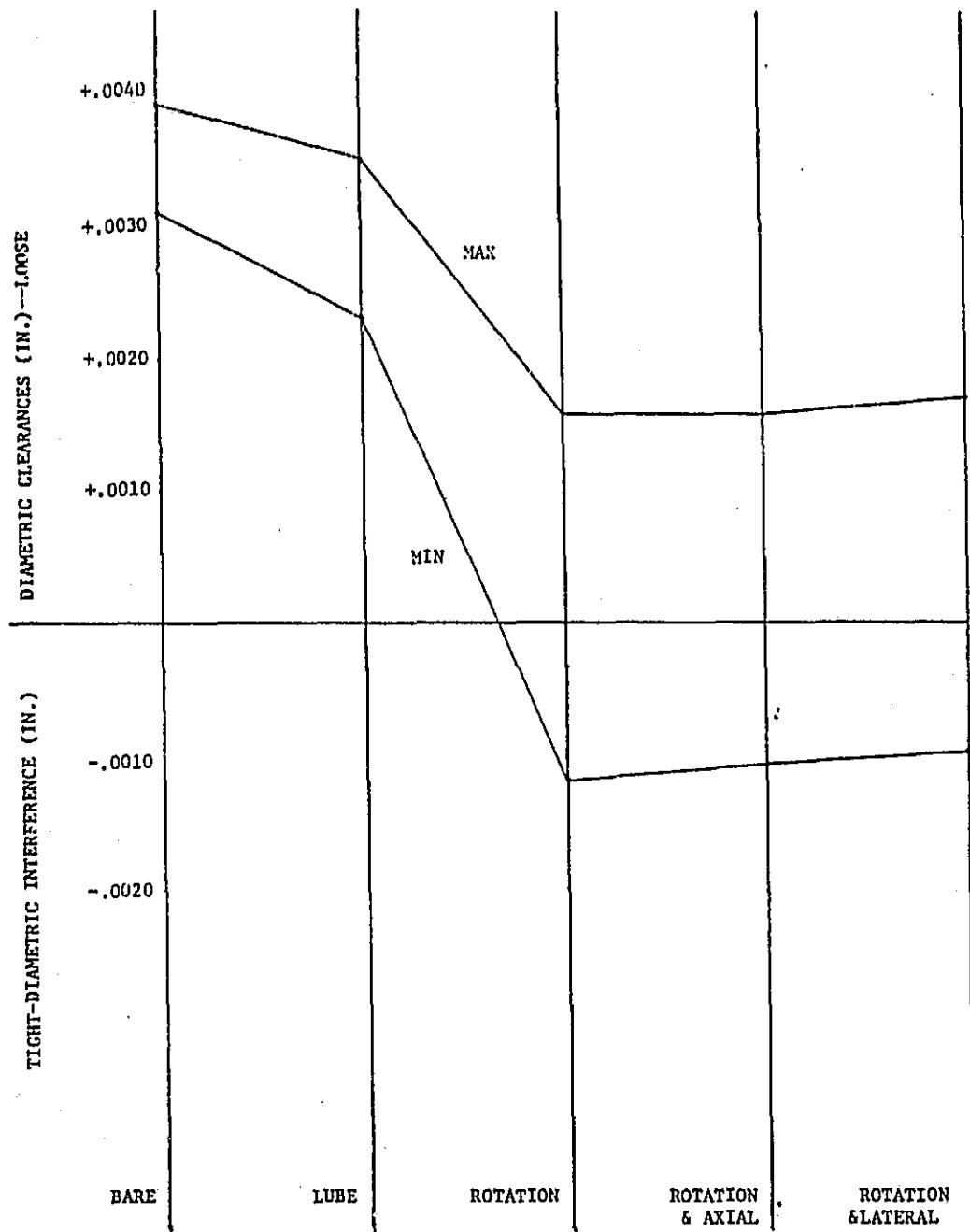


Fig. 38 Interface Summary for Bearing Carrier to Race 3
(Load Side, Point T)

Table 22 BEARING CARRIER (30A85208) TO BEARING 4 (RS007955-091)
POINT U

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Carrier i.d.	4.0636	4.0631
		Bearing o.d.	4.0597	4.0600
		Fit	+.0039	+.0031
2	Lube	Carrier i.d.	4.0634	4.0627
		Bearing o.d.	4.0599	4.0604
		Fit	.0035	.0023
3	Rotation	Diametric Change Due to Rotation	-.001313	-.002267
4		Net Fit - Bare: 1 + 3	+.002587	+.000833
		Lube: 2 + 3	(+.002187)	(+.000033)
5	Axial	Diametric Change Due to Axial	-.000987	-.00290
6		Net Fit - Bare: 1 + 5	+.002913	+.0002
		Lube: 2 + 5	(+.002513)	(-.0006)
7	Lateral	Diametric Change Due to Lateral	-.000875	-.002921
8		Net Fit - Bare: 1 + 7	+.003025	+.000179
		Lube: 2 + 7	(+.002625)	(-.000621)

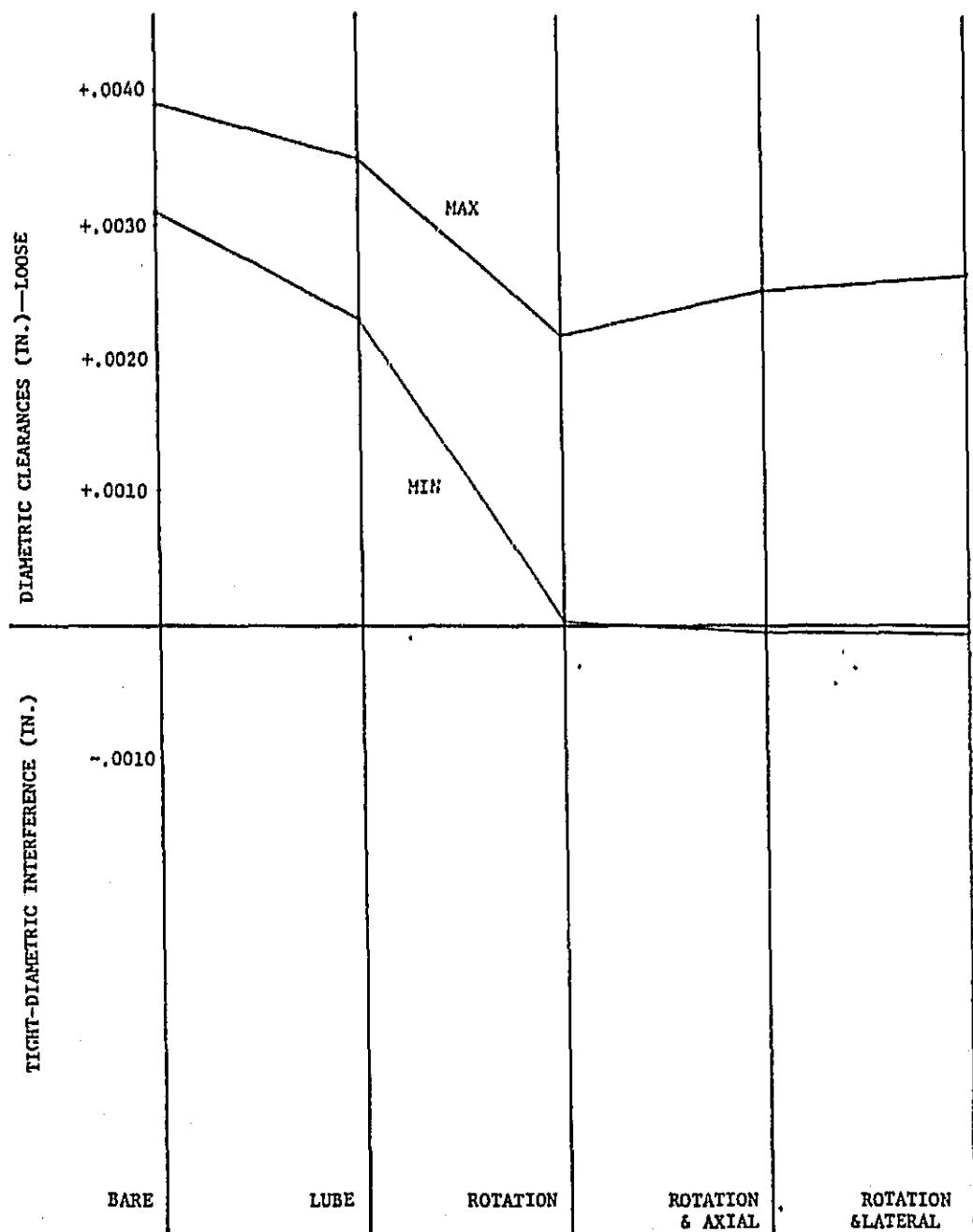


Fig. 39 Interface Fit Summary for Bearing Carrier to Race 4
(Load Side, Point U)

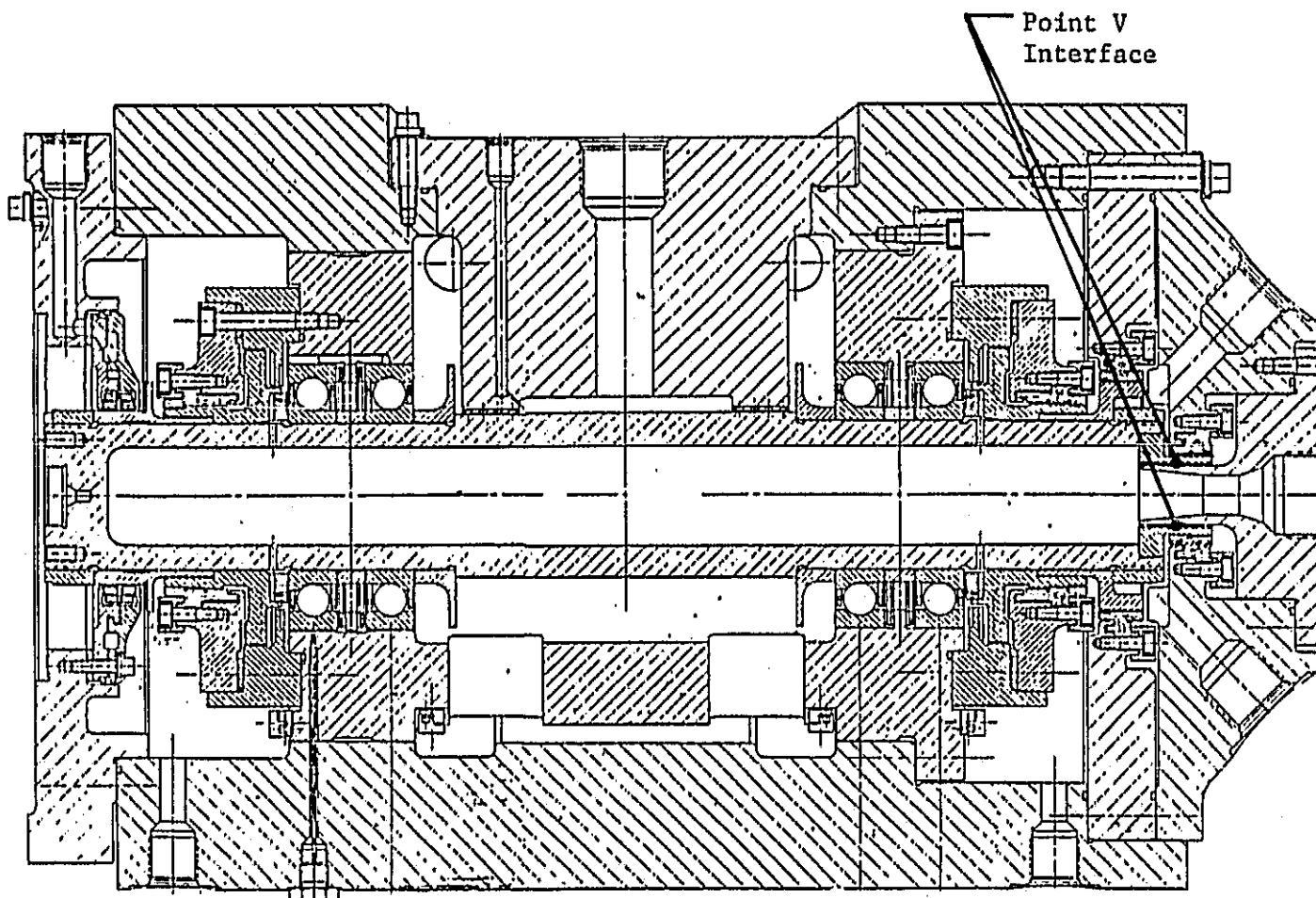


Fig. 40 Inlet Cap-to-Shaft Plug (Point V)

Table 23 INLET CAP (30A85228) TO SHAFT PLUG (30A85212)
POINT V

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
		Shaft Plug i.d.	.9537	.9381
		Inlet Cap o.d.	.8700	.8750
1	Bare	Fit	<u>.0837</u>	<u>.0631</u>
2	Lube			
3	Rotation	Diametric Change Due to Rotation	+.0007683	+.007240
4		Net Fit - Bare 1 + 3	+.08447	+.07034
5	Axial	Diametric Change Due to Axial	+.0008206	+.0006718
6		Net Fit - Bare: 1 + 5	+.08452	+.06377
7	Lateral	Diametric Change Due to Lateral	+.0007684	+.0003621
8		Net Fit - Bare: 1 + 7	+.08447	+.06346

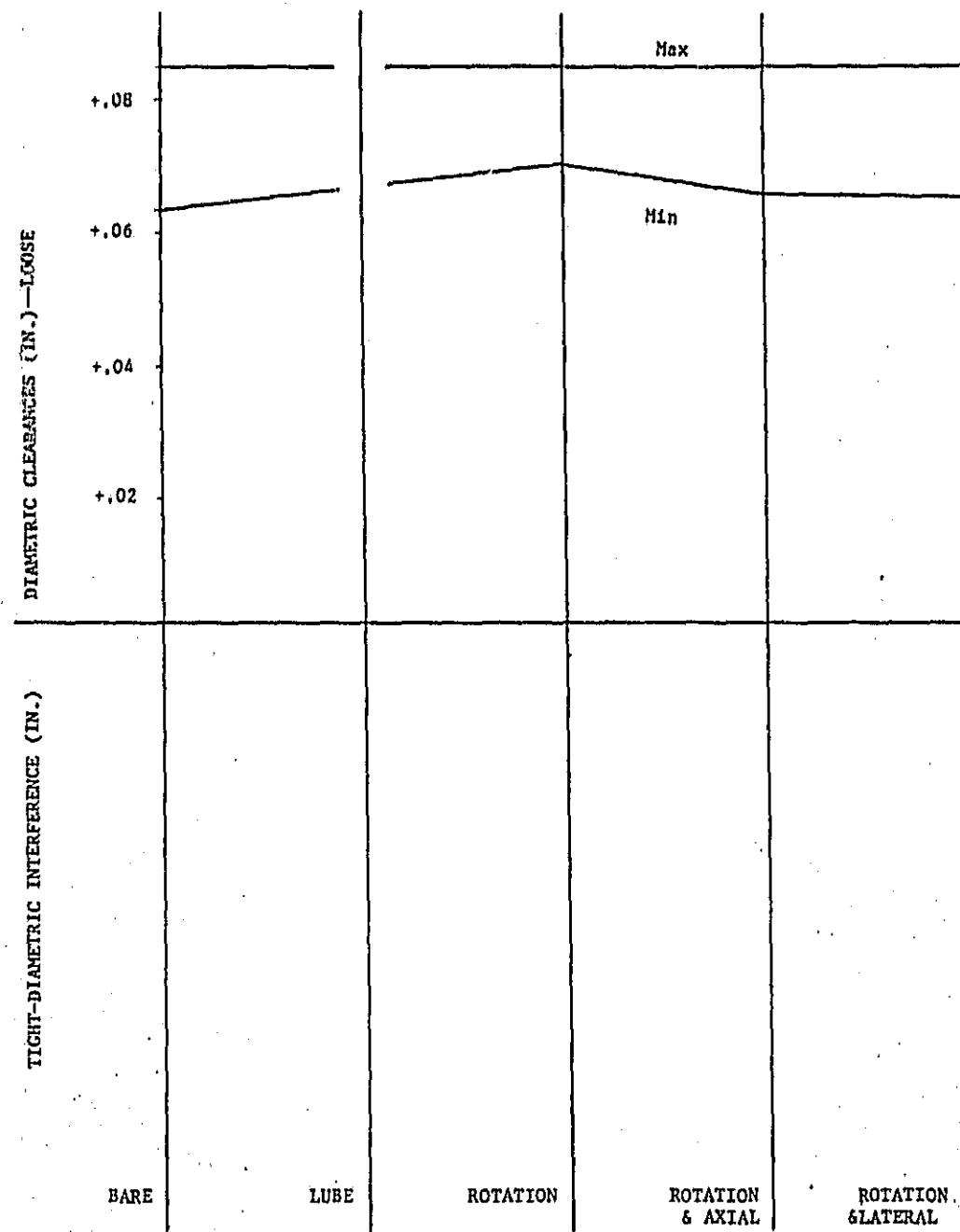


Fig. 41 Interface Fit Summary for Inlet Cap to Shaft Extension Plug (Point V)

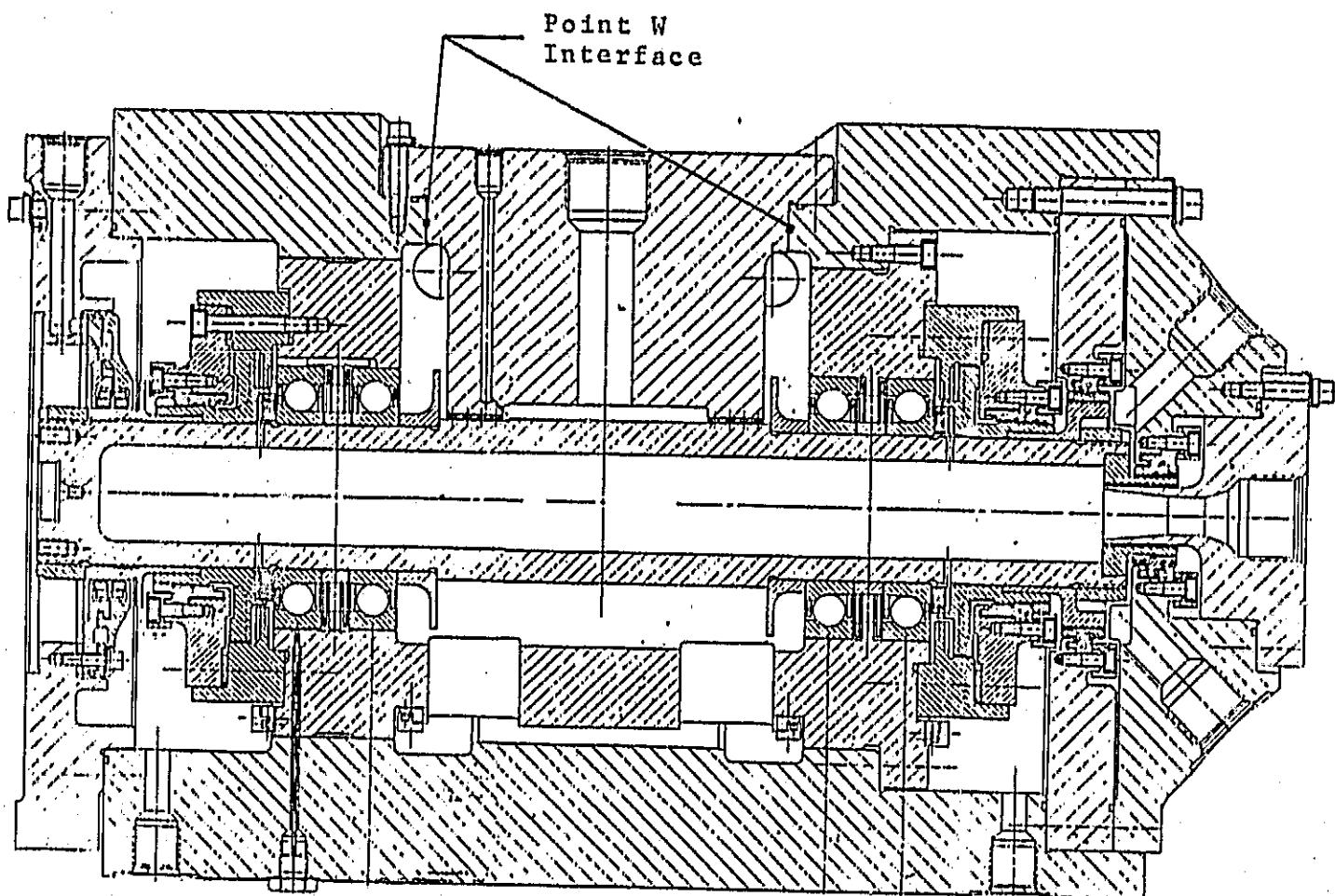


Fig. 42 (Axial) Saddle to Housing

Table 24 (AXIAL) SADDLE 930A852070 TO HOUSING (30A852L0)
POINT W

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Housing i.d.	5.747	5.746
		Saddle o.d.	5.749	5.750
		Fit	-.002	-.004
2	Lube	Housing i.d.	5.745	5.742
		Saddle o.d.	5.751	5.754
		Fit-	-.006	-.012
3	Rotation	Diametric Change Due to Rotation	+.02052	+.005169
4		Net Fit - Bare: 1 + 3	+.01852	+.001169
		Lube: 2 + 3	(+.01452)	(-.006831)
5	Axial	Diametric Change Due to Axial	+.020677	+.005199
6		Net Fit - Bare: 1 + 5	+.018677	+.001199
		Lube: 2 + 5	(+.014677)	(-.006801)
7	Lateral	Diametric Change Due to Lateral	+.020644	+.005206
8		Net Fit - Bare: 1 + 7	+.018644	+.001206
		Lube: 2 + 7	(+.014644)	(-.006794)

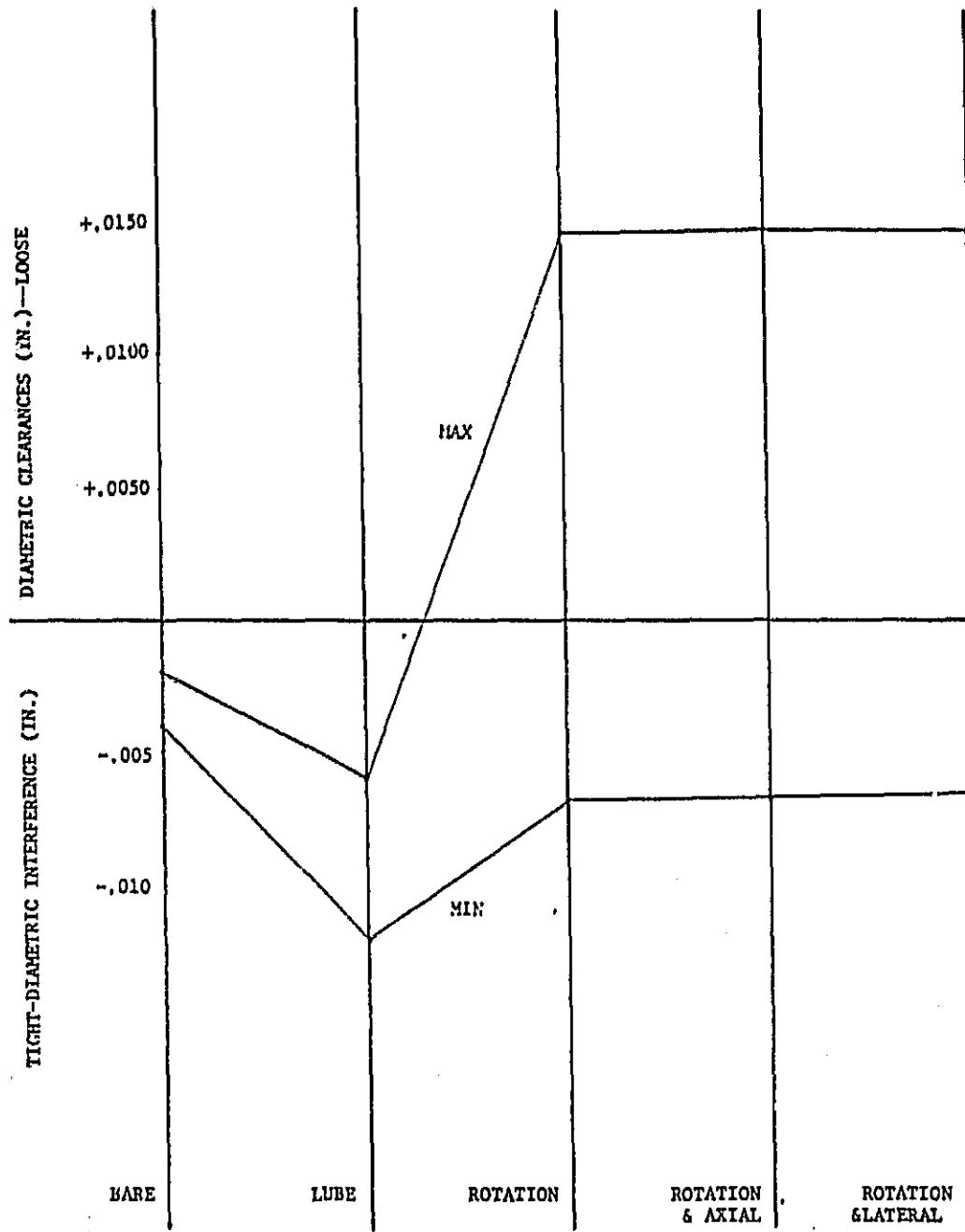


Fig. 43 Interface Fit Summary for Saddle to Housing (Point W)

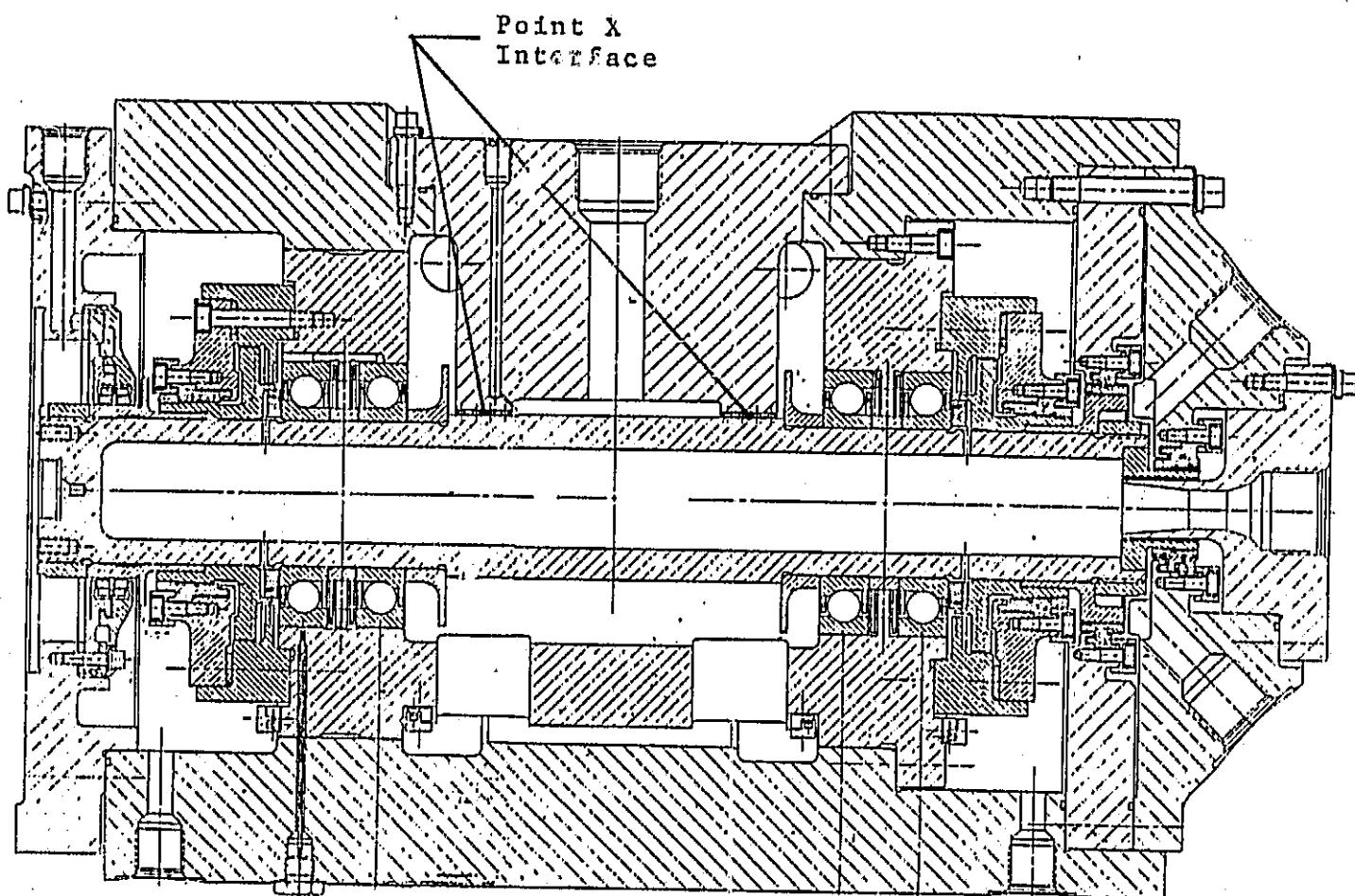


Fig. 44 - Saddle to Shaft

Table 25 SADDLE (30A85207) TO SHAFT (30A85211), POINT X

SL No.	Load Case	Detail	Radial Fit	
			Max.	Min.
1	Bare	Saddle* i.r.	1.25655	1.25600
		Shaft o.r.	<u>1.24985</u>	<u>1.25000</u>
		Fit	<u>+.0067</u>	<u>+.0060</u>
2	Lube	Saddle* i.r.	1.25645	1.25580
		Shaft o.r.	<u>1.24995</u>	<u>1.25020</u>
		Fit	<u>+.0065</u>	<u>.00560</u>
3	Rotation	Radial Change Due to Rotation	+.02753	-.00253
4		Net Fit - Bare: 1 + 3 Lube: 2 + 3	+.03423 (+.03403)	+.00347 (+.00307)
5	Axial	Radial Change Due to Axial	+.028625	-.0025496
6		Net Fit - Bare: 1 + 5 Lube: 2 + 5	+.035325 (+.035125)	+.003450 (+.00305)
7	Lateral	Radial Change Due to Lateral	+.034936	-.0235967
8		Net Fit - Bare: 1 + 7 Lube: 2 + 7	+.041636 (+.041436)	-.017597 (-.017997)

*Includes .0004 dia. centricity tolerance.

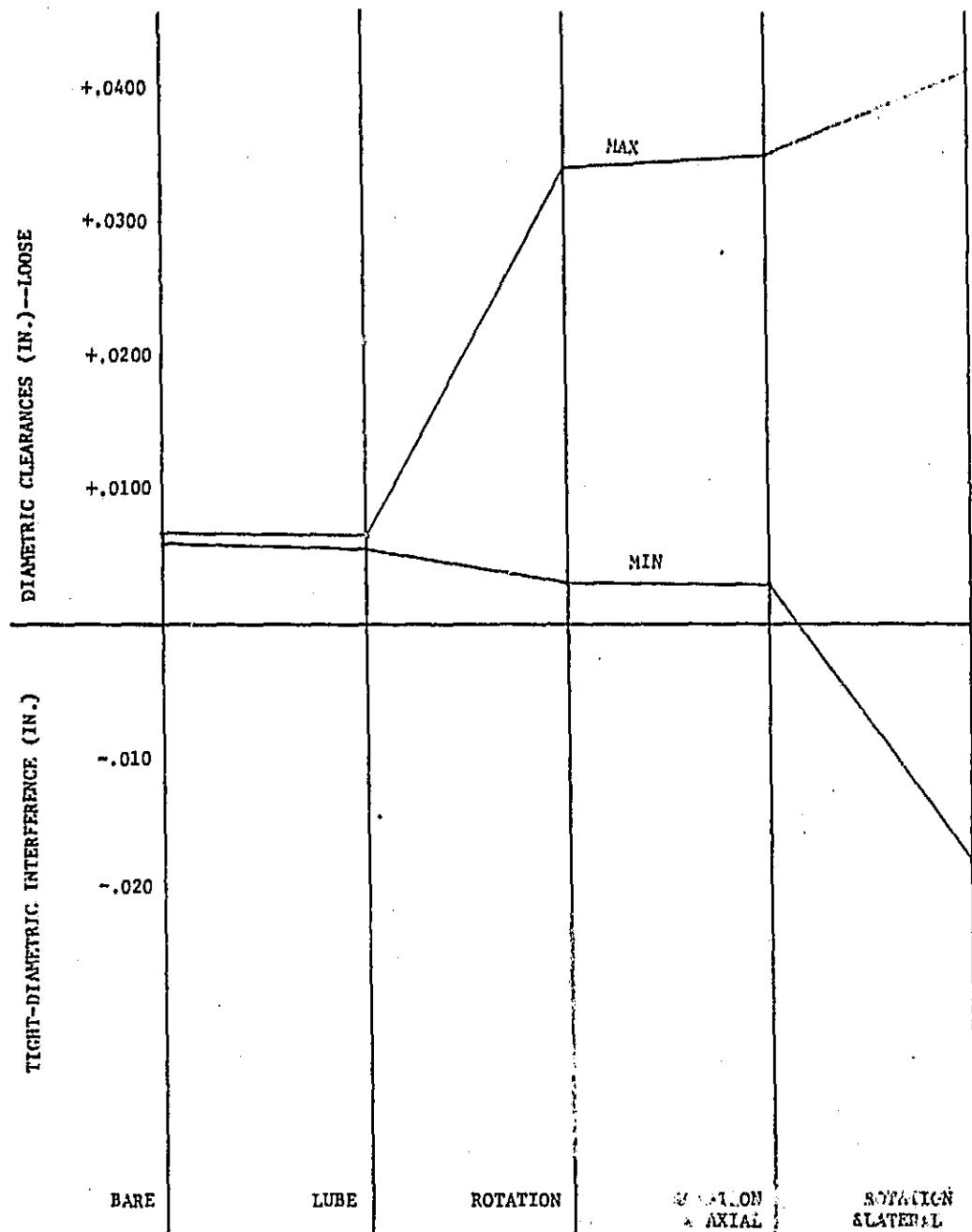


Fig. 45 Interface Fit Summary for Saddle to Shaft (Point X)

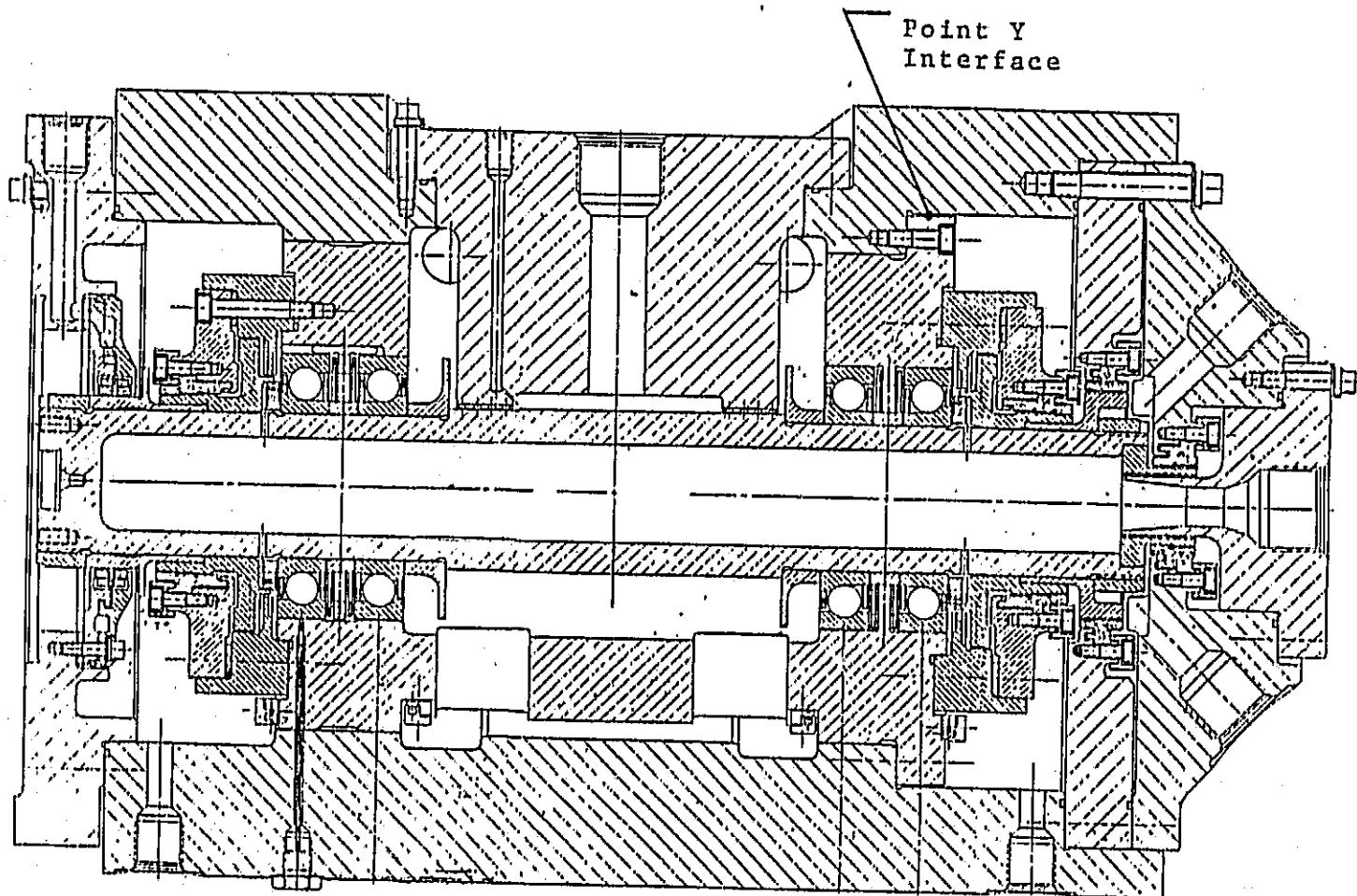


Fig. 46 Housing to Bearing Carrier

Table 26 HOUSING (30A852L0) TO BEARING CARRIER (30A85208)
POINT Y

SL No.	Load Case	Detail	Diametric Fit	
			Max.	Min.
1	Bare	Housing Carrier Fit	8.7537 8.7490 +.0047	8.7532 8.7495 +.0037
2	Lube	Housing Carrier Fit	8.7535 8.7492 +.0043	8.7528 8.7499 +.0029
3	Rotation	Diametric change Due to Rotation	-.0034506	-.0039742
4		Net Fit - Bare: 1 + 3 Lube: 2 + 3	+.005949 (+.0008491)	-.0002742 (-.001074)
5	Axial	Diametric Change Due to Axial	-.003537	-.0042115
6		Net Fit - Bare: 1 + 5 Lube: 2 + 5	+.001163 (+.000763)	-.0005115 (-.0013115)
7	Lateral	Diametric Change Due to Lateral	-.003265	-.004000
8		Net Fit - Bare: 1 + 7 Lube: 2 + 7	+.001435 (+.001035)	-.00030 (-.00110)

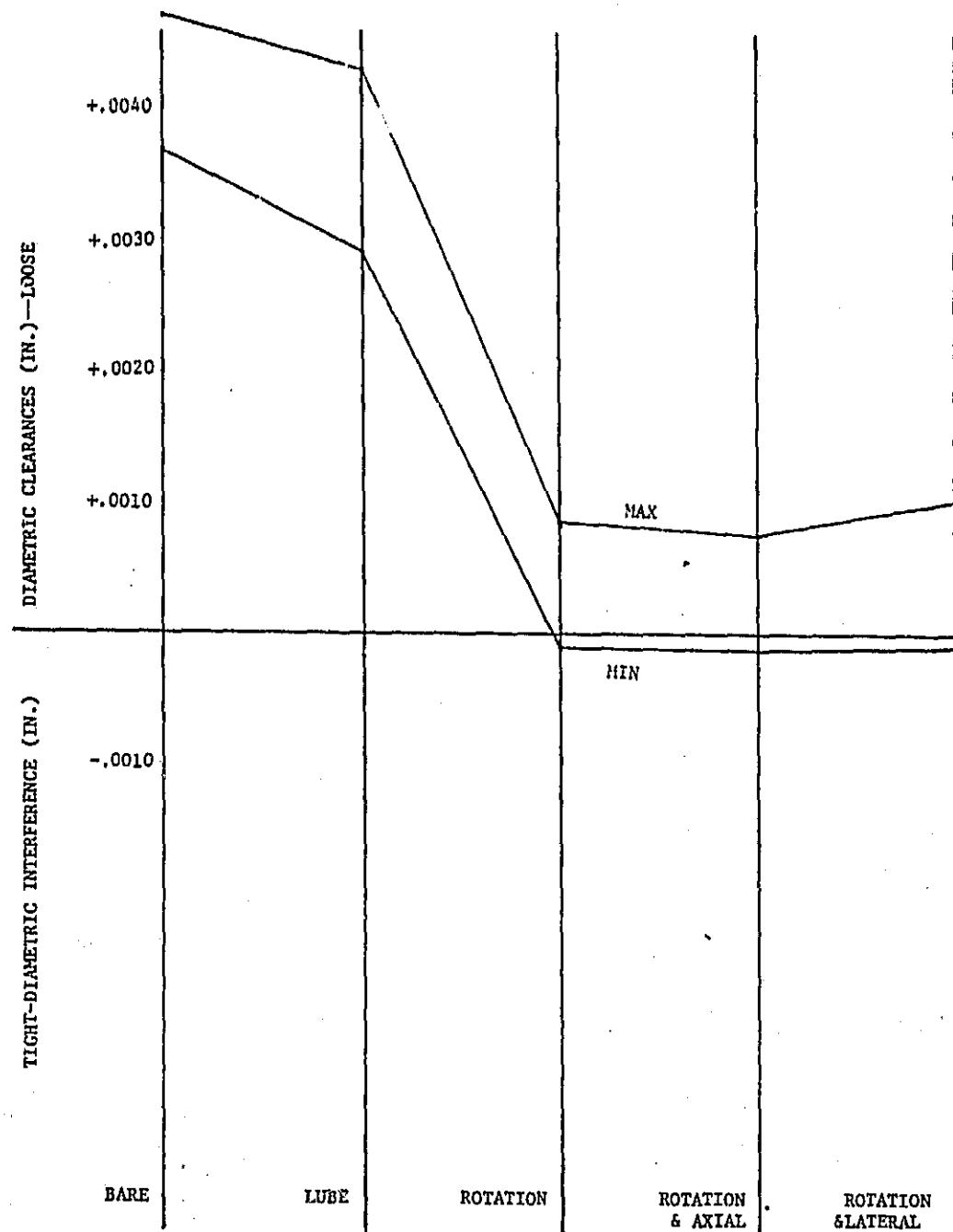


Fig. 47 Interface Fit Summary for Housing to Bearing Carrier (Point Y)